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SCIENCE NEWS LETTER

THE WEEKLY SUMMARY OF CURRENT SCIENCE •

JANUARY 7, 1933

Elected to Presidency of A.A.A.S.

See Page 3

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? DO YOU KNOW THAT ?

The greatest height reached by clouds in middle latitudes is about seven miles.

In a recent international comparison of the accuracy of time services, the U. S. Naval Observatory was rated the most accurate.

In the Morse telegraphic code, the lever is depressed for about one twenty-fourth of a second for a dot and three twenty-fourths for a dash.

To safeguard the Panama Canal against too much water in flood times and against too little in dry seasons, a special dam is being constructed.

Seeking wider usefulness for prunes, California scientists have devised a method of bottling prune juice, and have also made a prune breakfast cereal.

Student anthropologists at Harvard are given problems of excavating, in scientific fashion, bones and artifacts that have been planted in the earth in a "site" in the museum basement.

Some of the Egyptian linen found in old tombs is much finer than fine linen of today.

New help for cotton planters is an attachment which distributes seed at various depths in the row.

During the past 30 years, 900 makes of automobiles have been offered to the American public; today there are approximately 50.

The United States now has direct telephone connection with six South American countries: Argentina, Brazil, Chile, Peru, Uruguay, Venezuela.

Firemen are not the only ones to use tall ladders; archaeologists in the Near East have found an extension ladder useful in photographing ruins from above.

Woolly-finger grass, brought from South Africa, is being tested by Government scientists as a pasture plant for hilly lands of Alabama, Georgia and Florida.

WITH THE SCIENCES THIS WEEK

Curiosity arousing questions for the teacher and general reader. Book references in italic type are not sources of information of the article, but are references for further reading. Books cited can be supplied by Librarian, Science Service, at publisher's price, prepaid in U. S.

ASTRONOMY

Can Mars be seen during the early evening in January? p. 10.

How many Be-type stars are there? p. 7.

How much is it thought that distance to Europe varies? p. 14.

CHEMISTRY

How heavy is the world's heaviest water? p. 8.

COSMOGONY

Is the earth older than the moon? p. 9.

When will the universe contract? p. 4. *The Universe Around Us—Sir James Jeans—Macmillan*, 1931, $4.50.

ENTOMOLOGY

Will blood of all species of insects coagulate? p. 9.

GEOLOGY

When was the first known ice age? p. 8. *Ice Ages Recent and Ancient—A. P. Coleman—Macmillan*, 1926, $4.

MEDICINE

How did scientists learn the shape of germs they cannot see? p. 9.

How may distemper be prevented? p. 7.

NUTRITION

Is it necessary for civilized babies to lose weight just after birth? p. 3.

PHOTOGRAPHY

What old photographic process has been improved to make sharp enlargements? p. 8. *The Chemistry of Photography—Mallinckrodt Chemical Works*, 1932, 50c.

PHYSICS

What different energies do Dr. Millikan and Dr. Anderson attribute to cosmic rays? p. 6.

Which is the halogen whose activity with hydrogen is wrongly described in chemistry textbooks? p. 5.

Why do the stars keep shining? p. 3.

PHYSIOLOGY

What does the eye-stalk hormone do? p. 12.

PLANT PHYSIOLOGY

What length X-ray dose seems best for plants? p. 7.

How may dead plant roots be made to drink as much water as living roots? p. 8.

How much carbon monoxide is needed to make plants form new roots? p. 9.

PUBLIC HEALTH

Is diphtheria a greater hazard than smallpox? p. 9.

What impurity in drinking water causes mottled enamel of the teeth? p. 11.

What section of the country will feel the "flu" epidemic last? p. 8.

ZOOLOGY

What do sea-cows eat? p. 14.

Aardvark 229
Aartovaara, Gustave 149
Abbot, C. G. 121, 228
Abe, Noboru 395
Abruzzi, Duke of 231
Acalculia, disease 244
Accelerator-brake 312
Achiutla 317
Acidosis 281
Adam and Eve 105, 113, 118
Adams, Mildred 67
Adams, W. S. 99
Addisin 89
Addison's disease 227
Adel, Arthur 283
"Adenomata" 24
Adler planetarium 341
Adrenal glands 36, 227, 372
Agar-agar 237
Agricultural research 179, 182, 302
Air currents 328
Airplane radio 40
Airplanes 201, 292
Akron 222, 376
Alaska—forests 23
Albertus Magnus 200
Alchemy 106, 200
Alcohol 46, 52, 148, 244
Alcohol fuel 116, 301, 380
Alder 126
Alexander, Beulah H. 57
Alexander, James W. 55
Alexanderson, E. F. W. 313
Alfalfa hay 217
Alfriend, J. V., Jr. 104
Algae 53
Allan, William 318
Allard, H. A. 270
Allen, A. A. 280
Allen, Alexander J. 201, 283
Allibone, T. E. 69
Allison, Fred 149, 280
Aluminum 88
America, future 181
America—history 115
America—population 100
Amer. Assn. Adv. Science 3
Amer. Chem. Soc. prize 215
Anderson, Carl D. 6, 115, 120, 179, 332, 350, 355, 360
Anderson, E. M. 283
Anemia 36, 40, 101, 121
Anemometer 328
Animals, extinct 145, 150
Antelope 52, 53, 201
Antimony 106
Antiquity of man 269
Antitoxin—pneumonia 291
Ants, Australian 169
Ape psychology 339
Appel, William D. 196
Archaeology—Arabia 168
Archaeology—Assyria 83, 115, 361
Archaeology—Athens 212
Archaeology—Austria 189
Archaeology—Balkan 89
Archaeology—China 90
Archaeology—Dura 133, 196
Archaeology—Egypt 30, 193, 206, 310, 372
Archaeology—Ephesus 41
Archaeodogy—expeditions 169
Archaeology—Greece 212, 265
Archaeology—India 221
Archaeology—Jugoslavia 89
Archaeology—Mesopotamia 83, 113, 118, 196, 388
Archaeology—Mexico 30, 99, 149, 317, 374
Archaeology—Neb. 180
Archaeology—Palestine 92
Archaeology—Persia 65, 68, 221
Archaeology—Siberia 177, 185
Archaeology—Syria 105, 111, 169
Archaeology—Ur 291
Archaeology—Vikings 61, 168
Arctic night 137
Arctic ocean 37
Arcturus 307
Argand 140
Ariev, T. J. 232
Aristides 213
Aristoi 366
Arithmetic 244
Ark of the Covenant 259
Armstrong, Charles 9
Arsenic 24, 106, 108
Art—early Christian 133
Art, Jewish 196
Arthritis, rheumatoid 360
"Artificial pupil" 87
Ascidian 346
Aston, F. W. 120, 213
Astronomy 99
Astronomy, Indian 374
Atchley, Dana 372
Atlantic storms 379
Atlantis 312
Atmosphere—planets 99
Atmosphere, upper 216
Atom smashing 17, 26, 37, 88, 105, 121, 341
Atomic weights 116
Atoms 3, 5, 15, 72, 88, 89, 131, 180, 186, 213, 215, 376
Attitudes—public, private 61
Aurora 88
Australian ants 169
Automatic seismographs 163
Automobile deaths 227
Automobiles 41, 68, 117, 202, 312
Avendano, Don Esteban 149
Avers, H. G. 373
Awareness 62

Babies 3, 31, 269, 324, 382
Babies' eyes 269, 299
"Babying" 168
Bacteria 57, 221, 297
Bailey, L. H. 238
Bainbridge, K. T. 213
Bald eagle 105
Baldwin, Stanley 89
Ballance, Sir Chas. 124
Ballard, J. C. 328
Ballot, pottery 213
Bamberger, Louis 54
Banta, A. M. 38, 39
Barbital 212
Barker, Howard F. 100
Barley 55, 190
Barnard, E. E. 74
Barton, H. A. 136
Bartsch, Paul 221
Bathurst, J. E. 280
Bats 97, 102
Baudisch, Oskar 244
Bauer, C. Max 175
Bauer, Walter 316
Baumann, E. J. 229
Baxter, G. P. 116
"Bays," Carolina 202
Beams, J. W. 329
Beard, J. W. 261
Bears 222
Beasley, W. C. 269, 299
Beatty, R. T. 340
Beaver 168, 184
Beer 55, 206, 221
Beetle, Col. potato 89
Beetles 131
Behavior 31
Belding, David L. 264
Bell, Earl H. 180
Benedict, F. G. 265
Benn, James H. 361
Bernton, Harry S. 349
Bertholf, Lloyd M. 12
Beryllium 186, 213
Beutler, H. 335
Biblical names 316
Birch, T. W. 212
Birds 105, 206
Birth-rate 382, 394
Bishop, C. W. 90
Bishopp, F. C. 73
Bismuth 106
Bitter rubberweed 25
Bittinger, Charles 19
Bivings, Lee 382
Blackboards—metal 153
Blackett, P. M. S. 115, 120, 355
Blackwelder, Eliot 73
Blackwood, Oswald 21
Blair, T. A. 387
Blanchard, Frank N. 25
Blind 57
Blind spot 56
Blister rust 303
Blood 36, 261, 318
Blood—insects 9
Blood—tubules 360
Blood—diseases 89
Blood-forming hormone 89
Blood-tests 148, 154
Blotner, Harry 53
Boak, R. A. 56
Bodily development 260
Bog plants 233
Bohr, Niels 72, 328, 329, 332, 355, 361, 376
Bone development 393
Bone tapping 232
Book, Hanna M. 76
Books, spring list 249, 251, 252
Boothby, W. M. 67
Botanical names 382
Botany—collection 24
Bott, P. A. 36
Bowen, I. S. 264, 277
Bowman, Isaiah 182, 393
Bowman, Karl M. 365
Bowman, Paul W. 23
Boys, C. V. 391
Brackett, F. S. 20, 120
Brain—gorilla 318
Brains 294
Bramhall, E. H. 26
Bray, C. W. 232
Bread 206, 237
Breasted, J. H. 68, 361
Breitenstein, A. J. 132
Breuil, Abbé 228
Brick—electric furnaces 309
Brickwedde, F. G. 147
Briggs, Lyman J. 211
Bright's disease 312
Brodie, Maurice 21
Bromine 213
Bronze Age burial 380
Brooks, Charles F. 223
Brooks, Matilda M. 53, 234, 388
Brosius, W. L. 348
Brown, Roland W. 152
Browne, C. A. 26
Brownell, K. A. 227
Bruce 231
Brunsting, L. A. 372
Brush, Charles F. 195
Bryant, W. L. 263
Bubonic plague 164
Bugs 191
Bullock, F. D. 105, 228
Burgess, G. K. 211
Burnet, Arthur 233
Burnham, W. H. 366
Burns, G. Richard 20
Burns—treatment 381
Burrill, A. C. 123
Burton, E. F. 108
Burwell, Cora G. 7
Cacao research 302
Cadmium 213
Caesium 213
Cahill, B. J. S. 243
Calcium 195
Caldwell, O. H. 104
Caldwell, S. H. 120
California fault map 188
California Indians 29
Calvert, E. B. 366
Camera 179, 287
Camouflaging 207
Campbell, W. W. 275
Cancer 60, 84, 105, 108, 117, 120, 140, 153, 158, 195, 221, 228, 296, 300, 305 309
Cannon, Walter B. 267
Cape, Gladys 180
Carbohydrates 152, 195
Carbon dioxide 99, 120, 238
Carbon monoxide 9, 53, 154, 244
Carbon Mountain 211, 360
Carboxide gas 393
Carey, Walter C. 236
Carolina "bays" 202
Carpenter, C. M. 56
Carpenter, Rhys 265
Carrion, Daniel A. 72
Caso, Alfonso 149, 357
Cassini 314
Castle, W. B. 101
Castle, W. F. 349
Cat nursed by dog 181
Catacomb 33, 41
Caterpillars 19
Catfish 292, 395
Cathode ray 71
Cats 164
Cattell, J. McKeen 366
Cecil, Russell L. 360
Census, 1790 100
Centrifuge 329
Centrifuge microscope 308
Cent. of Prog. Expos. 149, 307, 323, 341, 357, 374
Cent. of Prog.—panorama 344, 345
Chadwick, J. 73, 115, 138, 360
Chaffin, Rafe C. 184
Chakravorty, P. N. 52
Chambers, L. A. 395
Chandler medal 46
Chase, Herbert 68
Chemical elements 341
Chemical flowers 135
Chemical sterilization 58
Chemical washes 58
Chemistry 207
Chemists, ancient 200
Chesney, Alan 229
Chicago World's Fair 307, 323, 341, 357, 374
Chickens 25, 293
Chiera, Edward 84
Child psychology 133, 216, 280
Children 179, 196, 216
Chimpanzee, pigmy 313
Chimpanzees 212, 340
Chloride ink 308
Chlorine 213
Chlorophyll 20
Cholesterol 60
Chronometer, accurate 325
Cipra, A. 229
City population 301
Clark, C. F. 83
Clark, Evans 72
Clark, H. C. 102
Clark, Sam L. 246
Clawson, A. B. 25
Clayton, H. H. 260
Clotted blood 360
Clouds, stratosphere 51
Cloven hoof 282
Clover, new 339
Clydesdale, Lord 230
Coal 132, 334
Coblentz, W. W. 56
Coca, Arthur F. 291
Cockcroft, J. D. 12, 15, 37, 72, 213
Cockroach 31
Coe, W. R. 349
Coffman, F. A. 73
Coins, Arabic 168
Cold germs 25, 169
Coleman, Marion B. 56
Collier, W. D. 232
Collip, J. B. 283
Colloidal arsenic 108
Color blindness 200, 244
Color change—crustacea 124
Colorado potato beetle 89
Colt, Samuel 203
Colt revolver 203
Colton, H. S. 115
Comet Peltier 132
Comet prints 49
Comets 216, 280
Compton, Arthur H. 6, 37, 185, 277, 323
Compton, Karl T. 26, 105, 197, 298
Comrie, L. J. 233
Concrete 330
Connolly, C. J. 318
Conrow, R. S. 153
Converse, H. T. 217
Conversion of mass 355
Cook, J. W. 43, 120
Cooke, C. W. 202
Coolidge, H. J., Jr. 313
Coolidge, W. D. 309
Cooper, G. P. 361
Cooper, John M. 28, 261
Cooperative phenomena 164
Cope, Edward D. 282, 283
Copeland, Jos. J. 53
Copper for anemia 36
Copper-plating 296
Corals 71
Corona—earth 275
Cortin 227
Corvusite 340
Cosmic "hiss" 339
Cosmic rays 6, 37, 41, 101 120, 179, 185, 264, 277, 350
Cosmical constant 131
Costa, J. L. 213
Coulter, J. M. 24
Cow 217
Crabs 331
Crampton, C. W. 366
Crane, H. R. 329
Crane, Richard 104
Creation of matter 355
Crew, Henry 345
Crickets 340
Crider, Blake 373
Crocker, William 9
Croneis, Carey 183
Crookes, Sir Wm. 148
Cross, Louise 292
Crustacea 124
Crystal models 326
Cuker, K. 202
Curie, Mme. M. 116
Curie-Joliot, Mme. Irene 213
Curman, Sigurd 61
Curme, G. O., Jr. 46, 185
Curtis, Asahel 67
Curtis, H. D. 74
Curtis, M. R. 105, 228
Cushing, Harvey 24
Cutler, Jessie T. 246
Cyanide 53, 234, 285, 296
Dahl, O. 88
Dam, Hoover 161, 165
Daphnia 38
Dark matter 265
Darling, S. L. 102
Darrow, Karl K. 124
Dart, F. Sheldon 168
Davidson L. S. P. 121
Davis, T. L. 200
Davenport, C B. 260
Davis, Bergen 15
Davis, C. L. 248
Davis, T. L. 135
Davis, Wm. Morris 239
Davy, Sir Humphry 362
Death rate 169, 173, 184
Death Valley 119
Deer 137
Degeneration 346
de Haas, W. J. 365
Delaney, J. P. 88
De la Vega, Garcilaso 237
De Morgan 140
Dennison, D. M. 283
Denny, O. E. 270
Densmore, Frances 186
Dental decay—prehistoric 6
Dental degeneration 36
"Depression" 183
Derby, H. L. 207
Deslandres, H. 204
De Soto, Hernando 84
de Terra, H. 200
Deuton 341
Dewey, John 366
Diabetes 309
Diamond, G. S. 309
Diamond, S. 233
Diet 259
Dilaudid 232
Diller, Theodor 377
Dimensions—space, time 139
Diphtheria 9
Dirac, P. A. M. 355
Disease 216, 297
Disease, mental 168, 196
Disease, new 292
Disease resistance 296
Disher, Dorothy R. 324
Distemper 7
Distillation—water 376
Dockeray, F. C. 324
Dodds, E. C. 43, 120
Dodge, Raymond 84
Dog nurses cat 180
Donaldson, H. A. 294, 295
Dorf, Erling 328
Dredging for gold 167
Drinking map 261
Drunken drivers 148
Dublin, Louis I. 22, 184
Ducks 206
Duel, Arthur B. 124

SCIENCE NEWS LETTER

Index—Vol. XXIII

Nos. 613-637—Jan. to June, 1933

Published by

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Tear out and insert in binder at beginning of volume

Duke, W. W. 389
Dumas, Georges 57
Dunham, T., Jr. 99
Dunlap, Knight 137, 358, 359
Dunn, L. H. 102
Dunning, W. F. 105, 228
Dura-Europos 259
Dust 297
Dwarfism cured 348
Dye, moth repellent 315
Dyes 196
Dyson, Sir F. W. 40

Eagle 105
Ear diseases 264
Earphones 212
Ears 86
Earth age 363
Earth appears blue 329
Earth origin 9
Earthquake map 188
Earthquake prediction 395
Earthquakes—Alaska 23, 275
Earthquakes—California 163, 267
Earthquakes—cause 163
Earthquakes—Cent. Amer. 313
Earthquakes—China 4, 109
Earthquakes—Japan 92, 156
Earthquakes—Madagascar 72
Earthquakes—measurement 109, 163, 172
Earthquakes—Mexico 296
Earthquakes—Peru 136
Earthquakes—Probilof Isl. 207
Earth's corona 275
Earthworms 59, 281
Eastland, C. J. 232
Eckardt, A. 72
Economic crisis—cause 165
Economy foods 191
Ecuador—chocolate ind. 302
Eddington, Sir A. S. 101, 131
Eddy, Nathan B. 232
Edgeworth, Harriet 67
Edison, Thomas A. 195
Edwards, F. S. 69
Eels 142
Egloff, Gustav 380
Egyptian Queen 310
Ehrenfest, Paul 92
Einstein, Albert 37, 54, 92, 172
Einstein window 55
Eisenhart, L. P. 55
Elder, J. H. 212
Electric discharge 241, 248
Electric motor 313
Electric transmission—music 243
Electric treatment—heart 317
"Electric eye" 104, 217
Electricity 197, 223, 298
Electricity & cancer 84
Electron 115, 131, 138, 185, 332
Electron, positive 179
Electronic tube 104
Element 87 149
Elements, rare 99, 149
Elvehjem, C. A. 36
Elvey, C. T. 276, 307, 365
Embryos 31
Emotions 312
Employment centers 328
Employment psychology 116
Endowments 76
Energy 213
Energy conservation 73
Energy from atoms 15
Energy into mass 213
Engelbach, Wm. 348
Engle, J. L. 211
Engle, Melvin D. 73
Eoanthropus 121
Eohippus 23, 123
Ewing, James 153
Ephedrine 67
Ephesus 33, 41
Epinephrine 67
Epstein, P. S. 350
Erythremia 89
Ether-drift 260
Ethyl alcohol 52
Euclid 139
Euphrates—archaeology 196
Evans, H. M. 309
Everest 230
Evergreens 79
Evers, N. 232
Evolution 138, 276, 346, 349, 378
Ewing, James 153
Explosions 149
Eyes 56, 137, 299, 377
Eyring, Henry 5

Facial expression 57, 124
Facial paralysis 125
Falcon 273, 280
Fallowing of land 179
Faraday 197
Farm relief 182
Fat 195
Fat-making molds 195
Faults 163, 188
Feldman, W. H. 297
Felson, Henry 89
Fer-de-lance 103
Ferguson, G. E. 201
Fergusson, S. P. 248
Fermented drinks 261
Fever 56
Fever, unusual 329
Fewkes, V. J. 89
Field, Ada M. 57
Field, R. M. 85, 328
Field Museum, Chicago 24, 356
Finch, G. 332
Finch 231
Fine, H. B. 55
Fingerprints 164
Finister, Ethel 25
Fink, Colin G. 88, 296, 389
Fink, David E. 24
Fire-fighting 153, 297
Fires 201
Fischer, Emil 187
Fischer, Franz 388
Fish 129, 132, 173, 379
Fish—disease 24
Fish fossils 263
Fish from Ur 291
Fisher, L. W. 56
Fleas 164
Flexner, Abraham 54
Flexner, Simon 55, 340
Flies 111, 137
Flood damage 323
Flosdorf, E. W. 395
Fluorescence 350
Flowers 58, 135
Foerderer, R. H. 201
Food and drug law 360
Foods, economy 191
Fordyce, John R. 85
Forests 23, 184
Forests—petrified 175
Forgery 164, 308
Formaldehyde 280
Fossil horses 122
Fossil plant 264
Fossil reptiles 136
Foulger, John H. 89
Foundations 20
Fowler, R. H. 120
Frandsen, Mikkel 147
Franklin, Benjamin 197
Franklin, Rachel 201, 283
Frost, Edwin B. 307
Frost-fighting 236
Fruit cultivation 361
Fryer, Douglas 216
Fuld, Mrs. Felix 54
Fumigation—ships 393
Fungi eat arsenic 334
Fungus 26
Furnas, C. C. 181

Gaerte, Wilhelm 168
Gaines, Newton 395
Galaxies 157, 265
Gall, Franz 294
Gall-bladder 115
Galton, Sir Francis 86
Galvanometer 90, 120
Gamma rays 133, 180, 360
Gamow, G. 124, 180
Gans, David M. 121
Garfias, R. 132
Garner, W. W. 270
Garrod, Dorothy 92
Garvey, C. R. 56
Gas 132
Gas tank 261
Gases cause combustion 26
Gases, poisonous 201
Gasoline truck 21
Gasoline-alcohol fuel 301, 380
Gates, F. L. 244
Gay, E. H. 21
Gebauer, R. 72
Geese 206
Geiger, J. C. 53, 234, 388
Geister, C. H. 201
Gelatin diet 312
Geldard, Frank A. 244
Generator 69, 105, 197
Genes 21, 349
Genetics 277
Genius 54, 294
Geography 182
Geological eras 183
Geology tour 328
Geophysical instruments 41
Gerlich, H. 348
Germanium 213
Germs 85
Gettler, A. O. 154, 392
Giacobini's comet 280
Giauque, W. F. 365
Gicklhorn, Josef 38
Giese, A. C. 350
Gilbert, Ruth 56
Glaciers 57
Gland, pituitary 24
Gland secretion 348
Gland, thyroid 200
Glands 36, 372
Glands affect cancer 153
Glass blowing 326
Glass eyebrows 310
Glass models 326
Gleason, P. R. 217
Globe 341
Glover, T. J. 211
Glucose 195
Glycine 67
Goats, nervous 246
Goetz, A. 287
Goiter 229, 283
Gold 30, 166, 167
Gondola, balloon 369, 372
Gonococcal vaginitis 293
Gorilla brain 318
Gortner, R. A. 19
Gowen, John W. 21
Grabfield, G. P. 312
Grain harvesting 182
Grand Canyon Nat. Mon. 41
Grand Coulee 67
Grasshoppers 40, 380, 392
Gray, Asa 266
Greaves, W. M. H. 297
Green, E. H. R. 136, 197
Greenbank, G. R. 156
Greenberg, Leon A. 238, 281
Greene, L. Wilson 238
Greenhouses 185
Greenlee, R. F. 228
Gregory, W. K. 138
Griggs, R. F. 23
Grosse, A. v. 73
Groundhog 63
Growth 179
Günther, P. L. 323
Guha, B. C. 52
Guilds, medical 72
Gulf Stream 312
Gum-jum 348
Gum-tsoy 348
Gunn, Ross 41
Gutenberg, Beno 172, 377

Habits 358
Haddon, A. C. 217
Hadley, George 184
Haeckel 138
Hafstad, L. R. 88
Haggard, H. W. 285
Haldane, J. B. S. 165
Hale, G. E. 204
Hall, G. Stanley 366
Hall of Science 345
Halverson, H. M. 212
Hambrecht, Leonora 89
Hamilton, B. E 297
Hamilton, Sir W. R. 139
Hammett, F. S 140
Hansen, Klaus 148
Hansmann, G. H. 292
Hanzlik, P. J. 53, 285
Happiness—cause 356
Ha-Reubeni, E 316
Harkins, W. D 121
Harrington, J. P 29, 315
Harris, Leslie J 212
Harrison, Ward 93
Hart, E. B 36
Hartman, A. M 217
Hartman, C. G 278
Hartman, F. A 227
Hartmann, G. W 86
Harvey, E. N 308
Haslam, J. A. G 201
Hatai, Shinkishi 379, 395
Haumeder, Eva 300
Hay 217
Hay fever 36, 349
Hayford, J. F 212
Haystack fires 26
Health 22, 169, 173, 216
Hearing—insects 232
Hearing tested 212
Heart 120
Heart disease 297
Heat 42, 121, 148
Heath, C. W. 101
Heath hen 308
Heavy water 280
Hebrew names 316
Heinrichs, C. E 117
Heisenberg, W. 3, 72
Helium 85, 186, 213, 287 363, 365
Heller, Hilda H. 392
Henderson 341
Henderson, E. P 340
Henderson, Y. 238, 244, 281, 285
Hendrick, A. C 108
Henry, Joseph 197
Herbs 350
Herschel, Sir John 76, 139
Hertz 298
Herzfeld, Ernest 68
Hess, Frank L 340
Hess, W. N 24
Hexuronic acid 212
Heyl, Faul R 212
Hibernation 222
Higgins, G. M 259
High blood pressure 318
High voltage 69, 104, 105, 197
High voltage generator 26
High voltage tube 136, 158
Hill, B. C 35
Hill, Sir Leonard 58, 100
Himalayas 200
Hindze, B. 294
Hipparchos 213
Hipparion 123
Hitchcock, A. E. 9
Hixson, A. W 46
Hodges, J. N 236
Hoffman, F. L 296
Hoffman, Malvina 357
Hoffmann, G. 120
Hofmeister 188
Holman, W. L 85
Homo sapiens 269
Hoof—evolution 282
Hooker, D. R 317
Hooton, E. A 36
Hoover, W. H 120
Hoover Dam 161, 165
Hopkins, C. 196
Hops 233
Hormone 36, 43, 89, 120, 153, 232, 267, 283, 309, 372
Horn, O. 388
Horse, fossil 23
Horse—evolution 122
Horton, R. E 281
Hough, Walter 147
Housefly 247
Houssay, B. A 309
Howe, M. A 71
Howell W. H. 393
Hrdlicka, Ales 264
Huber, E. 206
Huffer, C. M 265
Huggins, Sir Wm. 235
Hulbert, E. O 19
Hull, Callie 281
Hull, Harry E 312
Human biology 165
Humphreys, J. W 222
Hurricane data 366
Husbands 214
Hutchinson, W. S. 132
Hyatt, Thaddeus 330
Hybrid oak 281
Hybrids 73
Hyde, A. M 83
Hydrogen atoms 5, 8
Hydrogen flames 204
Hydrogen isotopes 147, 280
Hypertension 318

Ice Age 239
Ice Age Americans 180
Icebergs 170
Idealism 350
Illuminating gas 238
Inauguration weather 137
Incas 236
Indian exhibits, Exposition 344
Indian magic 28
Indian peyote religion 374
Indians—America 186
Indians—California 29, 315
Indians—Colorado 227
Indians—North Amer. 115, 374
Indians—Panama 147
Industrial research 281
Industrialism 181
Infant psychology 324
Influenza 8, 25, 40, 136, 173
Infra-red light 35, 58, 297
Ink—age detection 308
Inman, O. L. 20
Inorganic diet 303
Insanity 196
Insects 9, 312
"Inst. for Advanced Study" 54
Inst. of Radiation Therapy 309
Insulator 104
Insulin 53
Internal secretions 250
Inventions 27
Iodine 105, 116
Iron 142
Irvine 231
Islands 71
Isotopes 120, 147, 213
Israeli, N. 2
Ives, H. E. 2

Jaggar, T. A. 3
Jansky, Karl G. 3
Jeans, Sir James 3
Jenkins, C. F. 4
Jensen, M. B. 2
Jewett, F. B. 2
Jews 196, 2
Jig-saw puzzles 2
Jivaro head-hunters 3
Joffe, A. F. 2
Johns, C. K. 5
Johnson, E. R. 2
Johnson, G. E. 2
Johnson, T. H. 2
Johnston, E. S. 20, 12
Johnston, E. S. 12
Joliot, F. 2
Jones, A. E. 3
Jones, Brinley 19
Jones, B. M. 20
Jones, H. W. 20
Joule, J. P. 4
Judd, Neil M. 24
Jupiter 276, 3

Kampometer 12
Kapitza, Peter 8
Kaps, Leo 22
Karmán T. von 37
Kasanin, Jacob 168, 36
Katydids 23
Katz, Rosa 13
Keenan, P. C. 36
Keesom, W. H. 36
Keith, Sir Arthur 35
Kelly, S. F. 4
Kempf, G. F. 14
Kerr, Wm. J. 13
Khorsabad 36
Kowarzyk, H. 36
Kinney, F. M. 23
Kirsch, H. A. 18
Kirsten, F. K. 29
Kirwan 15
Kneser, H. O. 29
Knight, C. R. 15
Knight, Elizabeth 16
Knight, Harry H. 9
Knobloch, F. 32
Knudsen, V. O. 29
"Kolinit" 38
Kolnitz, H. von 20
Koltzov, N. K. 30
Koppanyi, T. 21
Kornhauser, A. W 11
Kouwenhoven, Wm. B. 31
Kovarik, A. F. 13
Kramer, P. J. 8
Kramers, H. A. 36
Krick, Irving T. 37
Kronfeld, P. C. 37
Krop, Stephen 21
Kropp, Benjamin 12
Kruse, H. D. 25
Küster, H. 38
Kugelmass, I. N. 3
Kurie, F. N. D. 13

Laboratory 20
Laboratory ship 31
Laboratory work cut 28
"Lace crabs" 10
Lain, E. S. 22
Lambs—disease 39
Lamp 81, 9
Land-fallowing 17
Land-fertility 17
Landslides—Carbon Mt. 21
Langer, R. M. 186, 329, 37
Langfeld, H. S. 6
Langmuir prize 21
Langworthy, O. R. 31
Lankester, E. R 34
Lanston, T. 9
Lanthanum 99, 11
Lantier, R. 38
Larch 7
Larrimer, W. H. 38
"Lastex" 9
Latex 9
Latimer, W. M. 9
Laughing gas 36
Laughlin, H. H. 27
Lauritsen, C. C. 104, 133, 32
Lavoisier, Mons. 15
Lawrance, E. O. 34
Lay, W. E. 11
Lead 19
Leake, C. D 5
Leakey, L. H. B. 26
Learning 2
Leather 20
Leavitt, E. P. 33
Lee, F. W 14

Lee, Robert C 265
Left handedness 121
Leighton, P. A 350
Leith, B. D 55, 190
Lemaitre, Abbé G. 37, 72
Lemery, N. 135
Lens, rapid 287
Leprosy 270
Levene, George 387
Lewis, G. N 158, 341
Lewis, Robert 293
Libby, W. F 99
Library window-displays 382
Lichtenburg figure 241, 248
Life expectancy 22, 184
Life processes 187
Light-sensitivity 244
Lighting 81, 93
Lightning 214, 385, 390, 391
Lindegren, C. C 56
Linder, Paul 221
Lion, extinct 150, 151
Liquid helium 287
Liquid measures 189
Liquor regulation 244
Lithium 213
Lithium atom 72, 213
Liver 216, 259
Liverworts 26
Livingston, B. E 4
Livingston, M. S 341
Lizard 181
Locher, G. L 6, 37
Lochhead, A. G 58
Lockwood, J. E 227
Lockwood, L. B 195
Locomotive model 149
Locusts 392
Loeb, Robert 372
Lönnqvist, Conrad 152
Loir, Adrien 164
Lokombitsika 238
London—Roman 20
Longevity 22, 165, 184
Longley, W. H 132, 331
Loomis, A. L 14, 152, 395
Lorimer, Frank 394
Lotka, A. J 22
Lotrich, V. F 227
Loud speaker 293
Low, Abraham 244
Low temperature research 85, 89, 287, 365
Low-voltage 72
Lucas, F. A 246
Luten, Frank H 246
Lyell, Sir Chas. 378
Lynch, J. S. J 313
Lyot, M. B 204

Macaws 47
McCallum, J. T. C 147
MacCarty, Wm. C 117, 300
McCollum, E. V 259
McCown, Theodore 93
McCoy, Elizabeth 57
McCoy, George W 211
MacCurdy, G. G 92
McDonald, Ellice 201, 283
McDonald Observatory 315
MacDougall, D. P 365
McGregor, J. C 293
Macht, David I 387
McHugh, Warden E 53
McKay, F. S 11
MacKenzie, D. B 69
McLaughlin, C. D 334
McMillin, E 238
McNeel, T. E 73
Macon 257, 270, 328
Magnet 89
Maisel, F. E 186
Malaria 25, 102
Maleic acid 156
Mallory 231
Man—origin 378
Man, prehistoric 57, 121, 269
Man, prehistoric—America 180, 184
Man, prehistoric—Asia 185, 200
Man, prehistoric—Denmark 380
Man, prehistoric—Palestine 92
Manwell, R. D 25
Manzer, C. W 312
Map, "butterfly" 243
Map—Fault system—California 188
Marine, David 229
Marine animals 327
Mark, Hermann 185
Marquina, Ignacio 374
Marriage 250, 388
Marsh, C. C 122
Martell, Charles 316
Martland, Harrison S. 392
Marx, Karl 51
Masks, painted 177, 185
Mass-energy equivalence 213
Mast, S. O 303
Mastodon 325
Mathematics 54, 148
Matter creation 355
Mattice, M. R 154
Maxwell, Clerk 298
Mayer, Walter 54, 92
Mayne, Bruce 307
Mease, Ralph T 104
Measures, liquid 189
Mechanical equivalent of heat 42
Mechanical invention 27
Mechanical man 344
Mediastinal tumor 316
Medical exribit 392
Medical guilds 72
Medical research 340
Medical training 394
Medicine—cost of care 72
Meigs, E. B 217
Mellon, R. R 56
Melton, F. A 63, 202
Men—mental processes 76
Menkin, Valy 297
Mental attacks 373, 377
Mental disease 168, 196, 365
Mental tests 312
Menzel, D. H. 100
Mercury 120
Mercy Hospital 309
Merriam, J. C 150
Merrill, P. W 7
Meryet-Amun 310
Metal blackboards 153
Metal films 332
Metals 168, 223
Metals—waste 19
Meteor crater 73
Meteors 202, 221
Methylene blue 53, 324, 285, 387
Micro-motion pictures 168
Microphone 184
Microscope 179, 308
Migration 206
Milk 217
Milk-corn food 191
"Milkorno" 191
Milky way 339
Milky way static 339
Miller, D. C 260
Millikan R. A. 6, 37, 55, 264, 277, 332, 350
Mills, C. A 264
Minerals—distribution 85
Mining—gold 167
Minnich, D. E 19
"Minus Colors" 265
Mironov, A. P 237
Mission Indians 315
Mississippi R. levees 236
Mitchell, C. L 222
Mitchell, W. C 27
Mitogenetic rays 361
Mixtec Indians 100, 149
Model of man 337, 344
Moersch, F. P 67
Mold 195
"Mold-oil" 195
Molds cause hayfever 349
Molecules 291
Molybdenum 218
Monkeys 25, 278
Monotype 91
Monte Alban 30, 357
Moon 297
Moon—effect on distance 14
Morgan, J. D., Jr 88
Morgan, W. W 276
Morris, Karl 245
Morris, R. S 89
Mortimer, Hector 387
Morton, C. V 339
Mosaic 111
Moseley, E. L 87
Mosquitoes 73, 307
Moth-proofing 46, 315
Moth repellent dye 315
Mothes, Kurt 233
Motion pictures 201, 286
Motion pictures—nerves 43
Motor fuel 301
Moultrop, I. E 73
Mount Everest 230
Mt. Locke Observatory 315
Mt. Wachusett 248
Mt. Washington temperature 223
Mt. Washington observatory 209, 223, 377
Moyer, R. A 41
M-rays 361
Mueller, H. O 326
Mull, J. W 239
Murphy, G. M 147
Murphy, W. S 212
Murray, M. R 31
Murrina 102
Muscular physiology 283
Museums 152, 381
Mushrooms 318
Musical transmission 243
Myasthenia gravis 67

Narcissus 225, 233
National Monument 41, 119
Natural resources 85, 88, 117, 132
Nauplius 346
Neanderthal man 6, 121
Nebulae 74, 131, 357, 365
Neferiti, Queen 372
Negative proton 179
Neher, H. V. 6, 120, 264, 277, 350
Nelson, Aven 24
Neodymium 99
Nerve fibers 43
Nerves 292
Nerves—grafted 124
Neurotics 214
Neutrons 73, 115, 121, 138, 179, 329, 360
New Background of Science 350
Newborn babies 324
Newson, H. W 121
Newton, Sir Isaac 350
Nicholas, J. S 31
Nicholson, S. B 99, 101
Nisqually Glacier 57
Nitrates, sea water 394
Nitrogen lack—plants 233
Nitrous oxide 362
Noel, John 231
Normandie 29
Norris, Charles 392
Norton, J. B. S 58
Nose 86
Novak, Emil 329
Oak 281
Observatory for time meas. 289, 303
Occhialini, G. 115, 355
Occultation of star 233, 276
Ocean bottom 72, 92
Ocean spray 56
Odell, A. F 8
Ogburn, W. F 27
Ogle, Cordelia 264
O'Hanlon, Sister M. E 26
Oil 132, 247
Oil fires 153
Oils—rancidity 156
Old-age 165
Olsen, J. C 201
Olson, Carl, Jr. 297
Onnes, H. K 365
Oppenheimer, J. P 355
Optimism aids arthritis 360
Orent, Elsa 259
Ores 142
Orne, Harold 223
Orohippus 123
Oroya fever 72
Osage orange 395
Oscillograms 232
Oscillograph 71, 120
Osterberg, A. E 195
Oxygen 99, 265
Oxygen isotope 147

Pabst, G. W 55
Pace, D. M 303
Pacific O. bottom 377
Pacific Science Cong. 364
Paine, Thomas 51
Paine, V. L 292
Palmer, C. E 179
Palmer, R. S 297
Panama—Tule Indians 147
Paneth, Fritz 323
Paralysis 21
Paralysis, facial 125
Parathyroid glands 232
Parents 168
Paresis treatment 307
Parker, G. B 207
Parker, G. H 292
Parker, J. R 392
Parker, R. C 360
Parkins, W. M 36
Parr, Albert 312
Paterson, D. G 328
Patterson, Wm. 147
Pattie, F. A., Jr 293
Pearse, A. S 331
Peking Man 57
Peltier, L. C 124
Peltier's comet 124, 132
Penicillium 195
Pepsin 195
Perkins, E. B 124
Pernicious anemia 89, 101, 121
Persepolis 68
Peruvian disease 72
Petrified trees 175
Petroleum 132
Petroleum—formation 154, 324
Petrullo, Vincent M 374
Pets for children 280
Peyote buttons 375
Peyote religion 374
Pfiffner, J. J 36
Phenomena, cooperative 164
Phillips, J. F 35
Phillips, T. E. R 297
Phlogiston 155
Phosphate 117
Photoelectric cell 104
Photography 8, 204
Photography—aerial 35
Photons 350
Physical allergy 389
Physical education 196
Physical instrument 120
Physics 164, 179
Piccard, Auguste 323
Pig spleen 24
Pigmy chimpanzees 313
Pigs 195
Piltdown man 121
Pine—disease 303
Pinkley, Frank 181
Piperidine vanadate 244
Pituitary gland 24, 283, 348, 387
Pituitary hormones 309
Planets 99
Plant quarantine 104
Plants 53, 71
Plants—diseases 104
Plants—growth 7, 9, 120
Plants—movement 355
Plastic surgery 124
Plesiosaur 136
Plesset, M. 355
Pneumonia 173, 291
Poison gases 201
Poison ivy 186
Poisons 53
Polar regions 239
Polar Year 248
Politics in Laboratory 207
Pollen extract 36
Pons-Winnecke comet 216
Poole, C. A 133
Population 69, 301, 356
Portland, Duke of 7
Pose, M. 88
Positrons 115, 179, 360
Posture 217
Potato 83
Potato, Peruvian 83
Pottery ballot 213
Power, M. H 67
Power plants 73
Prehistoric man 57
Price, E. D 31
Priestley, J. 155, 197
Printing-press 91
Private attitudes 61
Pronghorn 201
Propaganda 247
Protein 187
Proterozoic glacial age 8
Proton, negative 179
Protons 115, 131, 138, 179
Protozoa 283, 303, 321, 326
Psychology, child 31
Public attitudes 61
Public health 169
Pueblos, dated 293
Punishment 22, 233
Pure food bill 360
Purple gold 30
Pyramid—Tejupan 149
Pyramids, Mexican 374

Quantum mechanics 5, 92
Quarrell 332
Quarries, Egyptian 158
Quaternions 139

Rabbit embryos 31
Radiation 56, 101, 121, 133
Radiation—sun 228
Radiation—ultraviolet 56
Radiations—sky 264, 285
Radio 14, 71, 88
Radio from Milky Way 339
Radio interference 40
Radio tower 88
Radiolarians 321, 326
Radiometer 148
Radium 24, 133, 158, 180
Radloff, E. M 238
Rainbow 87
Raitt, W. 186, 376
Rancidity in oils 156
Ranyard, A. C 75
Raper, K. B 334
Rat-catching cats 164
Rat embryos 31
Rats 164
Ravenstone 340
Rawlins, T. E 9
Ray, S. N 2*2
Rayleigh, Lord 363
Rays, Infra-red 58
Redeemer—Indian 29
Redwood 191
Reeves, D. M 35
Reforestation 313
Regener, E. 101
Reh, Emma 99, 149, 317
Reid, Wm. D 120
Reinforced concrete 330
Relativity 4
Remington, R. E 200
Research—scientific 76, 275
Resin, artificial 388
Resistance to diseases 296
Respiration 265
Restoration of Vase 389
Revolver—patent 203
Reward 216
Rheumatism 100
Rheumatoid arthritis 360
Rhoads, C. P 101
Ribeyro, R. E 72
Rich, M. L 89
Richards, G. E 108
Richardson, R. D. 56
Richter, C. F 267
Richter, C. O 163
Rietz, H. L 24
Rifle—new type 348
Rink, Henry 170
Ritchey, H. E 315
Rivalry 216
Robins 239
Robinson, E. S 152
Robot 344
Rockwell, G. E 36
Roemer, Ole 235, 314
Roffo, A. H 60
Rogers, B. A 168
Roman London 20
Roos, C. F 3
Roosevelt, Mrs. F. D 191
Roots—water absorption 8
Rose, Flora 191
Rosenow, E. C 25
Rostovtzeff, M. I 133, 196
Rous, P 261
Rowan, F. D 239
Rowe, A. W 387
Rowntree, L. G 329, 372
Rubber 90
Rudnick, D 31
Ruedemann, R 108
Russell, H. N 1, 3, 4
Rutherford, Lord 364
Ruthven, A. G 40
Ruttledge, Hugh 230
Ryder, John A 282

Sabre-tooth cat 145, 150
Sacred drink 221
Sage, Priscilla 168
Salad dressing 57
Samarium 99
Sauer, Louis 89
Sauveur, Albert 168
Savel, P 213
Scarlett, A. E 88
Schaefer, R. L 348
Schaeffer, F. A 169
Schanck, R. L 61
Scheele, C. W 218, 219
Scheflan, Leopold 201
Schenken, J. R 292
Schevill, Wm. E 136
Schiff, Leon 89
Schizophrenia 365
Schmidt, J 142
Schmidt, P 169
Schorr, R 290
Schriever, Wm. 63, 202
Science—definition 361
Science quotations 345
Scientific apparatus 104, 197
Scientific instruments 90
Scientific progress 234
Scientific research 302
Scott, Howard 63
Scurvy-preventing vitamin 212
Sea bottom 220, 377
Sea level 373
"Sea lilies" 220
Sea-cows 14
Seals 387
Seidell, A 216
Seido, Endo 191
Seismograph 88, 163
Selenium 213
Self-polishing leather 201
Seligman 54
Selye, H 283
Semivectors 92
Senses 86
Sequoia Nat'l. Park 137

Serum ... 56
Serum-virus ... 21
Settle, T. G. W. ... 323
Sex activity ... 264
Sex control ... 300
Sex differences ... 76
Sex hormone ... 120, 293
Sex hormone, synthetic ... 43
Sherman, Mandel ... 373
Sherman, W. S. ... 36
Shapley, Harlow ... 9, 157, 265
Shear, M. J. ... 195
Shear, T. L. ... 212
Sheep poi-oning ... 25
Shelton, E. K. ... 393
Ship, largest ... 29
Shipworms ... 349
Shipwreck ... 154
Shoes, self-polishing ... 201
Shriner, L. R. ... 315
Shrinking of bones ... 316
Shröder, V. N. ... 300
Shull, C. A. ... 7
Sibiriakov ... 37
Silicon carbide refractory brick ... 309
Silk ... 104, 185
Silk, synthetic ... 185
Singer, H. D. ... 244
Singh, T. C. N. ... 179
Singleton, W. ... 197
Skin disease, new ... 292
Skin irritation ... 186
Skinner, Curtis ... 184
Skull change ... 387
Skunk cabbage ... 94
Sleeping potions ... 212
Slipher, V. M. 56, 264, 285, 329
Smallpox ... 236
Smiser, J. ... 328
Smith, E. R. ... 147, 376
Smith, E. H. ... 171
Smith, Elliot ... 57, 269
Smith, Erma ... 238
Smith, Gretta ... 382
Smith, M. C. ... 11
Smith, M. I. ... 216
Smith, Sinclair ... 90, 148
Smith, Wm. C. ... 196
Smyth, Wm. H. ... 63
Snakes ... 25, 102, 158, 169
Soddy, F. ... 51, 110, 125
Sodium amytal ... 147
Sodium pentobarbitol ... 147
Sodium vapor lamp ... 81, 93
Soil ... 59
Solar radiation ... 228, 260
Solar system ... 260
Sollenberger, P. ... 325
Soltan, Andrew ... 329
"Soma" ... 221
Sommer, Anna L. ... 280
Sound—chemical effect ... 395
Sound scale ... 284
Sound transmission ... 217
Sound waves ... 291
South Sea tribes ... 377
Soy bean paste ... 57
Space ... 139
Space—interstellar ... 357
Spectra—upper atmosphere ... 19
Spectrograph ... 213
Spectroheliograph ... 204
Spectrum of muscle ... 283
Spectrum research ... 148, 335
Spedding, F. H. ... 215
Speidel, C. C. ... 43
Speiser, E. A. ... 84, 115, 118, 388
Spengler, Oswald ... 287
Spinks, Sir Charles ... 158
Sponges ... 331, 365
Spontaneous combustion ... 26
Spontaneous explosion ... 186
Sprague, H. B. ... 20
Spring ... 168, 179
Spring flowers ... 270, 286
"Square Mug Ruin" ... 227
Stalagmite, brain-like 353, 361
Stanger, Margaret ... 180
Star, new ... 200
Star story ... 10, 70, 134, 198, 262, 342
Star velocities ... 235
Stars ... 74, 90, 157
Stars, Type Be ... 7
Stars—radiation ... 3
Starvation diet ... 259
Steam ... 73
Steamship ... 29
Stebbins, Joel ... 265
Steel industry ... 142
Stefansson, V. ... 137
Stereoscopic effect ... 281
Sterilizing milk cans ... 58
Stetson, H. T. ... 14
Stevens, A. W. ... 35
Sterling, M. W. ... 186, 355
Stock, Chester ... 150
Stokowski, L. ... 243
Stomach ulcer ... 195
Stone Age tools ... 228
Störmer, C. ... 51
Storms ... 88
Stout, A. B. ... 348
Stratosphere ... 216, 264
Stratosphere balloon ... 323, 372
Stratosphere clouds ... 51
Stratosphere gondola 369, 372
Stratton, S. W. ... 211
Strauss, M. B. ... 101
Streamlining ... 117, 201
String galvanometer ... 120
Strong, John ... 221
Struve, Otto ... 276, 307, 315, 357, 365
Strychnine poison—cure ... 147
Sturgis, C. C. ... 40
Sugar ... 202
Sugar as fuel ... 202
Sugar in plants ... 280
Sullins, John ... 184
Sullivan, Ruth ... 372
Sun ... 100, 152, 204, 216
Sunburn ... 56
Sun-fading ... 196
Sunspots ... 100
Super-galaxies ... 265
Super-scholars ... 54
Super-university ... 54
Surgery ... 124, 184
Susich, G. von ... 185
Swann, W. F. G. ... 277
Swans ... 206
Swanton, J. R. ... 85
Swingle, W. W. ... 36
Sylvanus, E. B. ... 57
Sympathin ... 267
Synagogue painting ... 259
Syphilis ... 307
Szalay, A. ... 152
Szent-Györgyi, A. ... 152

Tadpoles ... 347
Takahashi, Wm. ... 9
Tamarack ... 79
Tannic acid for burns ... 381
Taylor, H. S. ... 6, 280
Tchurakov, A. N. ... 8
Technocracy ... 46, 51, 63, 78, 93, 110, 125, 137
Teeth ... 223
Tejupan pyramid ... 149
Telephone, international ... 35
Telephone transmission ... 217
Telescope ... 315
Telixtlahuaca ... 149
Tellurium ... 197
Temperate zone fruits ... 361
Temperature—upper air ... 328
Tenayuca pyramid ... 374
Tepe Gawra ... 118
Teredos ... 349
Testing silk ... 185
Textiles—rubber ... 90
Theelin ... 232, 293
Thermodynamics ... 4
Thom, Charles ... 334, 349
Thomas, C. A. ... 227
Thomas, Karl ... 67
Thompson, J. H. ... 232
Thompson, J. W. ... 339
Thompson, W. S. ... 356, 388
Thomson, D. L. ... 283
Thomson, Elihu ... 195, 298
Thomson, Sir J. J. ... 115
Thought ... 76
Thunderstorms ... 71
Thurnwald, R. ... 377
Thurstone, L. L. ... 148
Thyroid gland ... 200, 293
Tidal wave prediction ... 335
Time ... 40, 139
Time keeping ... 325
Timothy hay ... 217
Tinklepaugh, O. L. ... 278
Tissues—growth ... 140
Tocantins, L. M. ... 200
Toennies, G. ... 140
Tolman, R. C. ... 4, 92
Tolonen, F. J. ... 142
Tomb robbers ... 310
Tomlinson, Supt. ... 57
Tooth decay ... 11, 239
Tornadoes—1933 ... 296
Tory, H. M. ... 364
Towle, F. B. ... 248
Townsend, W. C. ... 101
Toys ... 131
Transmission ... 217
Transmutation of elements 323
Transparent man ... 344
Trask, Parker D. ... 324
Traubenberg, H. R. von ... 72
Tree growth ... 334
Tree-ring calendar ... 293
Trees, fossil ... 152
Trelease, Wm. ... 281
Trilobite ... 108
Trojan, E. ... 365
Trout cataract ... 24
Truck, aluminum ... 21
Truck model ... 21
True, R. H. ... 313
Trumpler, R. J. ... 357
Tuberculosis ... 56
Tubules—blood ... 360
Tumor causes maturity ... 329
Tumor of parathyroid glands ... 316
Tumors ... 24
Tungsten ... 218
Türkel, Siegfried ... 308
Turner, C. E. ... 196
Turner, Scott ... 166
Tuscarora Deep—quake ... 156
Tut-Ankh-Amen ... 30
Tuttle, C. M. ... 286
Tuve, M. A. ... 88
Twenhofel, W. H. ... 57
24-hour clock ... 40
Typhoid ... 115
Typhus fever ... 152
Ulcer, stomach ... 195
Ultra-centrifuge ... 329
Ultra-sonic waves ... 152
Ultraviolet light ... 52, 201, 283, 350
Uncertainty theory ... 72, 328
Undulant fever ... 56, 297
Unemployment risks ... 24
U. S. Naval Observatory ... 289, 303
Universe ... 4, 131
University for geniuses ... 54
Urey, H. C. ... 147
Uvarov, B. P. ... 392

Vaccination ... 9, 89
Vaccine ... 56, 236
Vacuum tube ... 136
Vampire bat ... 97, 102
Van Atta, L. C. 26, 105, 136
Van de Graaff, R. J. ... 26, 105, 136, 197
Vanderslice, J. L. ... 54
Van Royen, Wm. ... 180
van Wert, L. R. ... 168
Vanzant, F. R. ... 195
Vars, H. M. ... 36
Vase, restored ... 389
Vasienko, Engineer ... 216
Veblen, Oswald ... 54
Veblen, T. ... 51, 78, 93, 110
Vegard, Lars ... 275
Velocity of light ... 314
Ventilation ... 58
Veronal ... 212
Veronica officinalis ... 266
Vibrations ... 152
Vikings ... 61, 168
Vipers ... 102
Viruses, filterable ... 9
Vision ... 86, 377
Vitamin A. ... 83, 185, 217
Vitamin B 52, 185, 191, 259
Vitamin B, ... 216
Vitamin B, ... 101
Vitamin C ... 185, 212, 229
Vitamin D ... 52
Vitamin G ... 191
Vitamins ... 216
Vitamins, synthetic ... 185
Vocational advice ... 328
Volume of sound ... 284

Wachmann ... 216
Walcott, C. D. ... 108
Wallace, H. A. ... 302
Walton, E. T. S. ... 12, 15, 37, 72, 213
Warburg, Otto ... 53
Ward, G E. ... 195
Ward, Henry B. ... 3
Washburn, E. W. ... 8, 147, 376
Washburn, M. F. ... 281
Waste—natural resources ... 19
Wastenays, H. ... 85
Water ... 147, 280
Water animals ... 326
Water—effect on teeth ... 11
Water, heavy ... 8, 376
Water power ... 140
Water—purification ... 104
Waterfall ... 67
Waterfield, R. L. ... 297
Water-flea ... 38
Waterhouse, W. L. ... 376
Waterman, A. J. ... 31
Waters, G. L. ... 180
Watson, Sir Malcolm ... 136
Watt, R. A. ... 71
Weakness disease ... 67
Weather 137, 169, 222, 373, 376
Weather and rheumatism 100
Weather-forecasting ... 153, 387
Weather map ... 260
Weather station ... 248
Webster, B. ... 229
Webster, L. T. ... 296
Wedgwood ... 59
Weeds ... 266
Weinberger, B. W. ... 6
Weinert, Hans ... 121
Weiss, LaBerta ... 324
Welch, W. H. ... 55
Wells, D. B. ... 381
Wells, R. C. ... 154
Wendel, Wm. B. ... 234, 285
Werner, A. A. ... 232
West, C. J. ... 281
Western civilization ... 287
Wever, E. G. ... 232
Weyl, Hermann ... 55
Wheat crop ... 182, 313, 347
Wheat rust ... 376
Wheeler, Wm. M. ... 169
Whelpton, P. K. 301, 356, 388
Whipple, G. H. ... 216
White, David ... 264
Whitford, A. E. ... 90
Whooping cough ... 89
Wilder, R. M. ... 67
Wilhelm ... 8
Wilcox W. F. ... 6
Williams, E. L. ... 27
Williams, F. T. ... 5
Williams, I. ... 23
Williams, O. B. ... 39
Willis, Bailey ... 17
Willoughby, R. R. ... 21
Wilson, O. C. Jr. ... 14
Wimmer, F. ... 18
Wind ... 9
Wind gusts ... 153, 37
Windaus, A. ... 5
Wings ... 36
Winlock, H. F. ... 31
Winnecke ... 21
Winston, James ... 23
Winter wheat ... 31
Winters ... 16
Wireless telegraphy ... 29
Wisconsin barbless barley ... 5
Witmer, H. L. ... 13
Wives ... 21
Wolfe, J. B. ... 33
Woltman, H. W. ... 6
Women ... 7
Wong, Chaak Y. ... 29
Wood, F. C. ... 15
Wood, Harry O. ... 163, 172, 188, 26
Wood, James J. ... 19
Wood, R. W. ... 30, 152, 39
Woods, R. V. ... 33
Wool ... 20
Word swallowing ... 18
World peace ... 8
World uniformity ... 18
"Worries" ... 21
Wycklif ... 19

X-ray ... 7, 37, 104, 133, 185, 217, 29
X-ray and cancer ... 153, 15
X-ray tube ... 305, 36

Yeager, J. F. ... 1
Yeast ... 22
Yellow fever ... 13
Yellow "white" potato ... 8
Yellowjacket Canyon ruins 22
Yellowstone Park ... 53, 17
Yerkes, R. M. ... 33
Youth ... 24

Zakarian, Z. ... 13
Zapotec pottery ... 15
Zeiss lens ... 28
Zerfas, L. G. ... 14
Zimmerman, P. W. ... 7
Zinc ... 21
Zinsser, Hans ... 19
ZoBell, C. E. ... 39
Zoological names ... 38
Zoology—expeditions ... 22
Zwemer, R. L. ... 37
Zwicky, F. ... 16

ERRATA, Vol. XXIII, Nos. 613-637, Jan.-June, 1933

PAGE	TITLE BEGINS	CORRECTIONS
12	Secretion	Line 7. Dr. Earle D. Perkins and Dr. Benjamin Kropp, of Rutgers University *for* Prof. Lloyd M. Bertholf, of the University of Western Maryland.
15	Economic Revolution	Par. 2, line 1. Cockcroft *for* Cockcoft.
55	Super-University	Col. 3, line 2. Millikan *for* Milliken.
55	New Barley	See corrected article on p. 190
63	Nature	Par. 2, line 10. *Delete* as the groundbog is of the New.
67	Waterfall	Line 7. Seattle *for* Portland. Line 10. Washington *for* Oregon.
140	Announcement	Heading. Priestley *for* Priestly.
156	New Quake	Col. 3, line 1. Nagasaki *for* Nagaaki.
159	The New Healthy	*Should read* THE NEW HEALTHY LIVING SERIES—C. E. A. Winslow and M. L. Hahn,
178	Do You Know?	Col. 3, line 1. 317,000 *for* 217,000.
198	April Evening	Par. 3, line 11. east *for* west *and* easternmost *for* westernmost. Par. 4, line 3. east *for* west. Par. 4, line 6. *Following the word* planet *insert* Mars, famous for its reddish color. Though Mars is decreasing slowly in brilliance, it is brighter than any star in the vicinity. *Transpose remainder of paragraph to column 2, line* 11, *to follow words* planet, which is. Par. 5, line 5. *delete* Mars *and remainder of paragraph.*
281	Wormwholes	Heading. Worm-Holes *for* Wormwholes.
285	"Sky Rays"	Last par., line 2. Royal Astronomical Society *for* Royal Society.
294	Brains	Par. 3, line 5. Henry H. *for* Henry A.
295	Brains	Cutline. Henry H. *for* Henry A.
313	Speed	*Delete* par. 4.
324	Announcemnt	Title. Deity *for* Destiny.
329	Strange Fever	Line 4. Leonard G. *for* Leonard C.
345	No title	Line 5. Aristotle *for* Aristole.
350	One-Celled	Par. 2, line 4. Fluorescence *for* flourescence.

ASTRONOMY

Atom Building Keeps Stars Shining, Says A.A.A.S. Head

4,200,000 Tons of Heat Per Second From Sun Called Mass Left Over From Element Forming Process

See Front Cover

THE BUILDING up of other heavier atoms out of hydrogen stokes the internal heat of the stars, including the sun, Prof. Henry Norris Russell, Princeton University astronomer recently elected president of the American Association for the Advancement of Science, suggested in the Maiben lecture before the Association.

The hardest problem of all star study is the source of the energy which keeps the stars shining, he explained. Synthesis and annihilation of atoms are the only two processes so far suggested which would supply enough heat to last for the millions of years of geological time.

Present theories indicate that the mutual annihilation of the positive and negative particles, the protons and the electrons, would not happen except at temperatures of many billions of degrees such as do not exist within the stars.

Prof. Russell's provisional theory is therefore that atomic synthesis makes the sun and stars give off heat and light.

"A Pound of Heat"

"The rate of loss of heat from a star is almost incomprehensively great," Prof. Russell said. "We can come nearest to realizing it by remembering that, according to the theory of relativity, heat, like other forms of energy, possesses mass. It is as proper to speak of a pound of heat as a pound of ice; but a pound of heat is a very large amount—enough, in fact, to melt 30 million tons of rock and turn it into white hot lava. The sun radiates heat away into the depths of space at the rate of 4,200,000 tons per second—and the sun is a smallish star! Upon what vast stores of energy can it draw to keep going?"

The mechanism for building heavier atoms out of hydrogen visualized by Prof. Russell is that suggested by the new and attractive theory of Prof. Werner Heisenberg, German physicist. Atomic nuclei are built up of protons and the recently discovered neutrons. The incorporation of a proton into a nucleus would in many cases change an atom of a known element into one of the following elements. For instance, beryllium of mass 9 would change into boron of mass 10, boron 11 would change into carbon 12. The introduction of a neutron would change an atom into an isotope of the same element, but with atomic weight greater by one, as for example, lithium 6 to lithium 7 and boron 10 to boron 11. By alternation of these processes the heavy elements might be built up, step by step.

1/130 of Mass Lost

The important feature of this process from the standpoint of keeping the stars stoked is that when a proton or hydrogen atomic heart is built into a heavier element, about 1/130 of its mass disappears and must be represented by heat liberated in the process. This is the loss of mass that has caused physicists to say that there is enough energy in a spoonful of water to run a liner across the Atlantic. Building in a neutron probably liberates heat in the same way.

"At distances greater than 1/1000 of the outer diameter of an atom," Prof. Russell explained, "protons and nuclei repel one another. A fast moving proton, rushing directly at a nucleus might, however, get so near it that attraction succeeded repulsion, and thus penetrate the nucleus and be- (*Turn to page* 12)

NUTRITION

Artificial Feeding Keeps Up Weight of New-Born Babies

A SOLUTION of dextrose or grape sugar, gelatin and common salt has been successfully used in combatting birth shock and keeping down to a minimum the weight usually lost by new-born babies, Dr. I. Newton Kugelmass, New York baby specialist, reported to the American Association for the Advancement of Science.

Studies of animals and of primitive tribes of men have convinced Dr. Kugelmass that the customary loss of weight in civilized babies just after birth is neither necessary nor normal. He criticized the usual modern practice of awaiting an ample food supply from the mother before feeding the new baby, and declared that the consequence is an initial period of starvation.

The birth mechanism produces the condition that he calls birth shock, he explained. New-born babies show all the characteristic signs and symptoms of shock, including low blood pressure, low blood sugar, sleepiness, stupor and lack of appetite. Refusing to accept these as normal, Dr. Kugelmass devised the gelatin-sugar-salt solution which he gives every two hours for the first 24 hours beginning immediately after birth. He finds it better than artificial feeding during the first two days of life and although it contains less calories than such feedings, it nevertheless reduces the loss of weight to the irreducible minimum of less than two per cent.

Science News Letter, January 7, 1933

GENERAL SCIENCE

American Association Elects New Permanent Secretary

AT THE MEETING of the American Association for the Advancement of Science in Atlantic City, Prof. Henry B. Ward of the University of Illinois was elected permanent secretary, to succeed Dr. Charles F. Roos, resigned. Prof. Ward is a veteran among American zoologists, and has (*Turn Page*)

PROF. HENRY B. WARD

for many years taken an active part in the administration of the Association.

Prof. Henry Norris Russell, Princeton University astronomer, who was elected president will preside at the Boston meeting during Christmas week 1933 and deliver the principal address of the 1934 meeting as retiring president.

Dr. Burton E. Livingston of Johns Hopkins University who for many years was permanent secretary, was reelected general secretary and John L. Wirt of the Carnegie Institution of Washington was reelected treasurer. Dr. Livingston was also nominated as representative of the A. A. A. S., on the board of trustees of Science Service.

Science News Letter, January 7, 1933

SEISMOLOGY

Catastrophic Earthquake Rocks Interior of China

CHRISTMAS brought to the isolated interior of China a very severe earthquake that was probably extremely destructive to life and property.

From reports wired Science Service by eight seismological observatories in different parts of the world, the U. S. Coast and Geodetic Survey determined that the shock occurred Saturday, December 24, 9:04.5 p. m., Eastern Standard Time at 38 degrees north latitude, 96½ degrees east longitude. This location is near Tsaidam Swamp.

It is likely that news of the probable disaster will not reach the outside world for several weeks.

Science News Letter, January 7, 1933

RADIO

The Science Service radio address next week will be on the subject

RECENT DEVELOPMENTS IN HIGHWAY RESEARCH

by

Prof. S. S. Steinberg

Department of Civil Engineering of the University of Maryland

FRIDAY, JAN. 13

at 12:45 P. M., Eastern Standard Time

Over Stations of

The Columbia Broadcasting System

COSMOGONY

Beginning and End to Universe May Fall Before New Physics

Prof. Tolman Pictures Infinite Life in Past and Future Instead of Universe Eventually Dying of "Heat Death"

SCIENCE and mankind are relieved of the necessity of considering that they live in a universe that was created at a definite time in the past or fated for stagnation and death in the future, if new principles of relativity and thermodynamics developed by Prof. Richard C. Tolman, California Institute of Technology "universe maker", stand the test of future discoveries.

Delivering the Josiah Willard Gibbs lecture before the American Association for the Advancement of Science, Prof. Tolman, who is a world authority on thermodynamics or the science of heat-energy and motion, extended thermodynamics to Einstein's special and general theories of relativity.

He arrived at findings that promise to have profound influence on philosophy and even religion as well as on science.

Now Expanding

Old-fashioned, classical science viewed the universe as running down in energy like a clock, eventually dying a "heat-death" when all heat and energy arrives at a dead level. Prof. Tolman's greatly simplified cosmological models hold the hope that under the new relativistic thermodynamics the universe can forever and ever experience a succession of irreversible expansions and contractions.

This fits in with the astronomical observations that we live in a rapidly expanding universe in which the great stellar galaxies are rushing away from us at speeds of thousands of miles a second. Prof. Tolman's tentative idea of the universe explains how it is possible that it is now expanding, that it previously contracted, that it will contract in the future and that this cycle will continue unendingly.

A creation or beginning of the universe is necessary under our ordinary, every-day, classical ideas. Prof. Tolman's marrying of thermodynamics with relativity may have removed the necessity of thinking of the universe having a beginning. In the "cautious position" to which he is taken by his mathematics and physics: "we no longer dogmatically assert that the principles of thermodynamics necessarily require a universe created at a finite time in the past."

Gibbs was the great American scientist who gave the classical principles of thermodynamics their most complete and comprehensive expression. Delivering a memorial lecture named in Gibbs' honor, Prof. Tolman told why it has become necessary to extend the classical thermodynamical principles to relativity that has so greatly influenced all science in the last two decades.

Classical thermodynamics was developed with the assumption that the things about him were at rest with respect to the observer. Prof. Tolman found it necessary to develop thermodynamics for observers in uniform relative motion to each other as is the case in the Einstein special theory of relativity.

The old-fashioned thermodynamics applied to space and time that had limited range and lacked strong gravitational fields. Prof. Tolman found it necessary therefore to extend thermodynamics to Einstein's general relativity in order to consider the heat-energy behavior of large portions of the universe. The older ideas of heat and energy needed refining in just the same way that Einstein found it necessary to develop a theory of gravitation that is more precise than Newton's.

Ordinary Principle Fails

Prof. Tolman detailed the technical modifications in thermodynamic theory needed to extend it to relativity and then gave examples of its "essential novelty and the inherent rationality of its consequences."

One strange consequence is that a system in which there is heat equilibrium will have higher temperatures where the gravitational field is stronger, although in classical thermo- (*Turn to page* 12)

DR. HENRY EYRING

CHEMISTRY

Dr. Eyring Explains Winning Accomplishment

This is the abstract of the paper on "Quantum Mechanics and Chemistry with Particular Reference to Reactions Involving Conjugate Double Bonds" which won the $1000 prize of the A.A.A.S. Atlantic City meeting.

By DR. HENRY EYRING, Princeton University.

THE UNIVERSALLY accepted conception of atoms as positive nuclei surrounded by electrons make it seem obvious that some sort of mechanics of such particles will properly describe their chemical behavior. The success of quantum mechanics in atomic physics where it gives quantitative agreement with experiment, shows us clearly enough the general means to be employed. Because of the complexity of the mathematics, we must use a perturbation theory. A careful application of a perturbation theory, however, may be expected to be as fruitful as such methods have been found to be in astronomy, for example. Among the many results already obtained only a few bearing most directly on the problem in hand can be mentioned.

Heitler and London's calculations for the homopolar bond (*Turn to page* 15)

CHEMISTRY

Chemist Who Works in Library Wins Coveted Award

Textbooks Proved Wrong by Achievement of Young Scientist Which Brings Him A.A.A.S. $1000 Prize

A YOUNG CHEMIST who works with mathematical equations in a library instead of with chemicals in a laboratory has won the $1000 American Association for the Advancement of Science prize for the Atlantic City meeting because his applications of the new quantum mechanics of physics to binding energies between the atoms (valence) have resulted in predictions later verified by experiments. These show that in some cases even elementary text books in chemistry are wrong.

Dr. Henry Eyring, research associate and assistant professor in Dr. Hugh S. Taylor's Frick Chemical Laboratory at Princeton University, is the prize winner. He is 32 years of age.

He has applied quantum mechanics to several branches of chemistry. Through his calculations he utilized the binding energies between atoms in solving problems of how rapidly chemical reactions occur.

The first notable success of his work came two years ago when he showed the conditions governing the conversion of parahydrogen to orthohydrogen. These are two molecular arrangements or varieties of ordinary light-weight hydrogen (atomic weight one) which Prof. Karl Bonhoeffer, then of the Kaiser Wilhelm Institute at Berlin and now at Frankfurt, demonstrated experimentally. There was question as to just how the para sort of hydrogen changed over to the ortho arrangement of the hydrogen atoms. Dr. Eyring's calculations showed that the conversion proceeds more easily by interaction of an atom with a molecule, and not through mere molecular rearrangement.

Mistaken About Flourine

Next Dr. Eyring studied the interaction of hydrogen with fluorine, bromine, iodine, and chlorine, those chemicals known as the halogens. His applications of the new physics showed that contrary to all chemical expectation fluorine is really the least reactive of these chemicals with hydrogen. All the texts and technical chemical literature declared the opposite, that fluorine reacts much more easily than the other elements, chlorine, bromine and iodine.

Here was a clean-cut test of Dr. Eyring's methods. From Germany through experiments performed by Dr. H. Von Wartenburg of Danzig came the verification. He prepared pure fluorine and pure hydrogen and found that they would not react at room temperature. This is what Dr. Eyring predicted and now textbooks that state the contrary are out of date.

Mathematics of Heavy Hydrogen

To the problem of separating ordinary hydrogen from the heavy weight hydrogen discovered a year ago, Dr. Eyring's latest developments of quantum mechanics are applied. This work is not yet announced and will be published in a forthcoming issue of the *Proceedings of the National Academy of Sciences*. At the Bureau of Standards in Washington Dr. E. W. Washburn found recently that when electric current breaks down water into hydrogen and oxygen gas, the first hydrogen given off is almost all lighter hydrogen or the wellknown isotope of mass one. The double weight hydrogen isotope of mass two is given off practically not at all in the early stages of electrolysis. Dr. Eyring has shown that this is a necessary consequence of his method of calculating the speed of chemical reactions when applied to surfaces such as those of the electrodes through which the electricity is applied to the water.

In his prize paper delivered to the American Association, Dr. Eyring extended his methods to organic chemistry. Bromine might be added to an organic molecule, butadiene, by two alternative methods. Dr. Eyring calculated which of these methods occurred more easily. His result indicates that the addition occurs in that manner which experiments by organic chemists had showed to be that actually occuring. But he also showed by calcu- (*Turn Page*)

lations that the reaction should not occur at ordinary temperatures when only the gaseous substances are present. He therefore concludes that the reaction which commonly occurs must be accelerated by other substances present, either by solvents or by impurities in the two compounds, which are known as catalysts.

Catalysts or "parson chemicals" play extremely important roles in many industrial chemical processes, being key or trigger substances in hydrogenation, fixation of nitrogen and many other processes even though they do not partake in the reactions themselves. The theoretical pencil-and-paper work of Dr. Eyring therefore promises to illuminate some of the mysteries in this field of chemistry. Dr. Hugh S. Taylor, head of Princeton's chemistry department, has fitted Dr. Eyring's theoretical work into an extensive program of chemical exploration that is now in progress.

Dr. Eyring was born in Mexico of American parents and while an American by heritage and training he is finding it necessary to take legal steps to acquire American citizenship. He is married and has one child. Chemistry is his recreation as well as his vocation.

He was trained as a mining engineer at the University of Arizona, received his Ph. D. in chemistry in 1927 at the University of California, spent 1929-30 at the University of Berlin as National Research fellow, then returned to the University of California as an instructor under the famous Dr. G. N. Lewis. He has been research associate and assistant professor at Princeton since September, 1931.

Science News Letter, January 7, 1933

ANTHROPOLOGY

Man Had Toothache 50,000 Years Ago

MAN'S prehistoric ancestor, Neanderthal Man of 50,000 years ago, must have had toothache, too. Evidences of dental decay and impacted teeth dating that far back are described by Dr. Bernhard Wolf Weinberger, dentist of New York City.

The earliest dentists used some of the same materials, such as gold and silver, and some of the same type of instruments that are now used in dentistry. Pre-Inca Indians sought for means of preserving the individual tooth when it was diseased or decayed, while Old World dentists seem only to have been interested in supplying missing teeth.

Science News Letter, January 7, 1933

PHYSICS

Millikan and Compton Debate Cosmic Ray Facts and Theories

Leaders in Physics Agree About Most of Experiments But Uphold Different Theories Concerning Strange Radiation

TWO OF America's leading physicists, both Nobelists, discussed facts and theories about cosmic rays before the American Association for the Advancement of Science.

About most of the experimental facts they agreed. About the deductions from thousands of experiments performed by scores of investigators ranging the world, they largely disagreed.

Dr. Robert A. Millikan, of California Institute of Technology, upheld strongly as a fact his conclusion that the cosmic rays that enter the earth's atmosphere are photons, like X-rays and gamma radiations of the same family as light and heat.

Dr. A. H. Compton, of the University of Chicago, found "no way of reconciling the data with the hypothesis that any considerable portion of the cosmic rays consists of photons." He concludes that cosmic rays come from outer space as high speed electrified particles, either negatively charged electrons or positively charged protons.

As to what causes the discharging of the sensitive electrical instruments used in detecting the effects of cosmic radiation, Drs. Compton and Millikan agree. Very energetic electrified particles produce the effect, but whereas Dr. Compton considers them the original rays, Dr. Millikan advanced evidence that they are secondary radiation produced in the earth's air by photons smashing into the hearts of air atoms.

X-ray Similarity

To account for the very penetrating radiations that Dr. Millikan and others have observed in the depths of lakes, Dr. Compton countered with the suggestion that electron cosmic rays produce photons in the earth's atmosphere just as electrons striking an X-ray tube target produce X-rays.

His argument fell in line with experimental evidence for a new process of ionization presented to the same session by Dr. Gordon L. Locher, a National Research fellow at the Bartol Research Foundation, near Philadelphia. X-rays are produced in the gas of a detecting chamber by the passage through of swiftly moving particles like electrons, according to Dr. Locher.

Reporting the results of airplane flights this past summer in the United States, Canada and Peru, at altitudes up to twenty-one thousand feet, Dr. Millikan explained that a new type, very sensitive, recording electroscope developed with Dr. H. Victor Neher showed differences in cosmic ray readings at high altitudes that may possibly be explained by a new cause, a modification of the earth's electrical field connected with some secondary influence of sunlight. Changes in the earth's negative electric field such as occur between day and night would change the resistance to the inflow of the secondary negative particles generated by the cosmic rays. But the rays that get down to sea level are so hard that the earth's electrical field would not affect them. This fits in with a lack of significant latitude variation in cosmic ray readings made at sea level by Dr. Millikan and others recently and in past years.

Magnetism Blamed

Dr. Compton and his associates in a world-wide survey during the past eighteen months found larger variations with latitude in cosmic ray intensities on the tops of high mountains. This he attributes to the effect of the magnetic field of the earth, since the earth's magnetism would theoretically keep electrified-particle cosmic rays from reaching the equatorial regions where the Compton experiments show cosmic rays to be less.

As to the energies of cosmic rays, there is difference of opinion. Dr. Millikan cited the experiments of his colleague, Dr. Carl D. Anderson, to show that observed cosmic ray energies lie largely below five hundred million volts and that less than a tenth reach the billion volt range. (*Next Page*)

Dr. Compton advanced an energy of seven billion volts for the electron cosmic rays that are so feeble as not to reach the equator, and he set thirty billion as the figure for a more penetrating component of high speed electrified particles. The high energy portion is not affected by the earth's magnetic field, Dr. Compton held.

As to the way in which cosmic ray effects vary with increase in height over the earth's surface, there is little difference in the experimental results, but both Dr. Millikan and Dr. Compton see the experiments bolstering up their theories.

The question of the origin of the cosmic rays, a moot question upon which there is little experimental evidence except the fact that they come from outer space, was left for future meetings.

Science News Letter, January 7, 1933

ASTRONOMY

Discovery Doubles Number Of Known Be-Type Stars

DISCOVERY of 236 stars in the northern Milky Way with layers of glowing hydrogen surrounding them was announced to the American Astronomical Society by Dr. Paul W. Merrill and Cora G. Burwell, of the Mt. Wilson Observatory.

These are known as type Be stars, and are especially interesting to astronomers because of some of their peculiar properties. The Mt. Wilson astronomers have been making a search for them, using the spectroscope to study the lines in the stars' spectra. As a result the total of known Be stars has been raised to 408.

Science News Letter, January 7, 1933

PLANT PHYSIOLOGY

Growth of Plants Stimulated By Proper X-Ray Treatment

X-RAYS can cause plants to grow faster, blossom earlier, form more chlorophyll, and in general speed up their life processes. But if they get too much of a dose of the rays, they become cripples.

This in brief summary is what Prof. Charles A. Shull of the University of Chicago has found in experiments which he reported before the meeting of the American Society of Plant Physiologists.

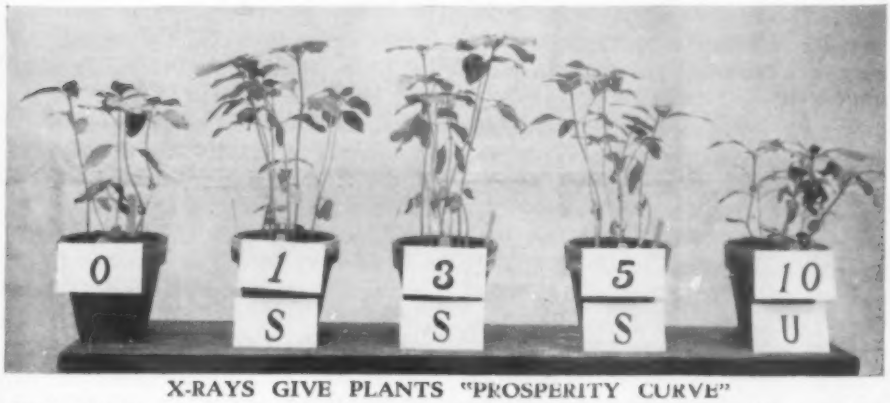
Prof. Shull exposed corn, wheat, oats and sunflowers to X-rays for periods of from one to five minutes inclusive, under screens to take out the harmful parts of the X-ray spectrum, and also for ten minutes without the benefit of screening. He compared the growth of these planets with "control" plants that were not X-rayed at all.

All the rayed plants except the ten-minute lot apparently were stimulated by the treatment. In some cases they became juicier, or more succulent, as well as larger. In corn a considerable increase of the green food-making substance, chlorophyll, was noted, running from 20 to 60 per cent. above the controls. X-rayed seeds carried on their respiratory processes with greater energy, the data indicating from 30 to 50 per cent. increase.

The three-minute treatment seemed to be most beneficial especially in the case of the sunflowers. Pots of the young plants ranged side by side mark off a curve with the graduated heights of their tops: good at one minute, best at three, not so good at five, and disastrous for the ten-minute treatment without a screen. The plants were in bud at about the same time, but the three-minute group blossomed first.

The condition of the ten-minute group indicated emphatically the effects of too much of a good thing. It was badly burned, and pocked all over the leaves, as though with a mosaic disease. The leaves were irregularly lopsided, an effect not observed at all in the plants given shorter rayings under screens.

Science News Letter, January 7, 1933



X-RAYS GIVE PLANTS "PROSPERITY CURVE"

Prof. Charles A. Shull of the University of Chicago gave sunflower seedlings varying doses of X-rays, and found that they stimulated growth. Figures on pots indicate number of minutes' raying. Ten minutes, unscreened, hurt the plants; shorter exposures helped.

VETERINARY MEDICINE

Conquest of Distemper May Protect Fur-Bearers

COMPLETE success in protecting dogs and other animals against distemper is claimed in the final report of "The Field" Distemper Council, of which the Duke of Portland is president, as the result of ten years' research in England.

A virus, a vaccine, and an anti-serum have been produced, and a healthy dog can be given lasting protection against distemper infection by the inoculation of vaccine followed a fortnight later by one of virus. If the anti-serum, used alone, is given sufficiently early in the disease, it will lessen the severity of an attack of distemper.

A survey of the results with the vaccine-virus method showed that, where exposure to infection was certain, the incidence of distemper among 650 foxhounds belonging to 23 hunting packs was only 1.4 per cent., and the deathrate 0.3 per cent. Without inoculation the incidence among young foxhounds in England is nearly 100 per cent., and the deathrate frequently 50, and sometimes more than 75 per cent.

As true distemper has recently been found to occur among fur-bearing animals related to the dog, such as the silver fox, or to the ferret, such as fitch, mink, and fisher, these methods will have immediate value where these animals are farmed.

Science News Letter, January 7, 1933

CHEMISTRY

World's Heaviest Water Exhibited on Scales

THE WORLD'S heaviest water was shown to scientists at the meeting of the American Association for the Advancement of Science in Atlantic City. Two flasks of water were exhibited on a sensitive weighing balance and the visitors saw for themselves that one of them was heavier than the other.

The U. S. Bureau of Standards at Washington where this heavy water was obtained under the direction of Dr. E. W. Washburn, head of the chemistry section, sent the exhibit. Scientists have realized that there are two kinds of water, one lighter than the other, only since the discovery about a year ago of an isotope or atomic form of hydrogen that has an atomic mass practically twice that of the more prevalent sort of hydrogen.

In nature one out of about 30,000 atoms of hydrogen is double weight. It was discovered at the Bureau of Standards that when water is broken into hydrogen and oxygen by passing an electric current through it, the hydrogen gas given off contains more of the lighter or isotope one hydrogen than normal. When this light hydrogen is burned it produces a water of lower specific gravity than the water of nature.

But the chemists found that the water left in the electrolytic cells contained increasing amounts of the heavy-weight hydrogen as the electrolysis continued. It is possible to secure in this way water that is one part in a thousand heavier than ordinary water. Later the government chemists hope to obtain by the same method water that is even heavier.

Science News Letter, January 7, 1933

PLANT PHYSIOLOGY

Though Dead, Plant Roots Continue to Drink Water

ROOTS of plants do not need to be alive in order to take in water. Experiments still further shattering the broken theory of "vital activity" or "pumping" by roots were reported to the American Society of Plant Physiologists by Dr. Paul J. Kramer of Duke University.

Dr. Kramer killed the roots of potted plants by heating them, but did so in such a manner as to leave the green tops still alive and demanding water. Then he supplied water to the dead roots. He found by careful weighing that the roots still took in water, though not at as high a rate as they did while they were alive. This decrease however, he ascribed to partial injuries to the upper parts of the plants by the root-killing process.

When a vacuum pump was attached to the stems of plants from which the tops had been removed it was found that water passed in more rapidly from the soil through dead than through living root systems. The reduction of the moisture content of the soil brought about by living and by dead roots attached to a vacuum pump was approximately the same.

"Since in these experiments water was so readily absorbed through dead roots it seems that the importance of the role played by the living cells of roots in absorption has been over-emphasized," Dr. Kramer concluded. "It appears that the intake of water by transpiring plants is due largely to the tension or negative pressure developed in the hydrostatic system by the removal of water in transpiration and other processes. It is probable that the tension produces a purely physical gradient of decreasing pressure between the water in the soil and the water in the xylem vessels and it is largely as a result of this gradient that water moves from the soil into the roots."

Science News Letter, January 7, 1933

PHOTOGRAPHY

Old Process Improved To Enlarge Photos Better

AN IMPROVED revival of the old wet collodion process photographic plates promises to make available to scientists and photographers enlargements that do not lose sharpness and detail.

Dr. Allan F. Odell, chemist with the duPont Viscoloid Co., reported the method to the American Association for the Advancement of Science. He has perfected a method that develops in 35 to 90 minutes contrasted with 6 to 48 hours necessary before. Many plates and films can be processed simultaneously whereas the old method handled one plate at a time. In the process of physical development used, the silver for the image is obtained from the developer solution and not from the plate.

Science News Letter, January 7, 1933

IN SCIEN

GEOLOGY

Earth Had Glacial Age Billion Years Ago

WHEN LIFE on the earth was very young, in the Proterozoic Age, which was perhaps from two-thirds of a billion to a full billion years ago, the planet was already chilly enough at times to support a full-fledged glacial epoch.

Evidence to this end was presented in a paper sent to the Geological Society of America by Dr. A. N. Tchurakov, Leningrad geologist. Dr. Tchurakov has found, in the southern part of Middle Siberia, an area of about a quarter of a million square kilometers, in which rocks of Proterozoic Age contain erratic pebbles and boulders which in his opinion represent glacial materials rafted and dropped there by icebergs when that land was part of the sea bottom.

Science News Letter, January 7, 1933

PUBLIC HEALTH

"Flu" Epidemic Expected To End in January

THE INFLUENZA outbreak is expected to end in January. Although an enormous increase in the number of cases was reported from state health officers throughout the country to the U. S. Public Health Service for the week ending December 24, health authorities believe that the end is now in sight.

The epidemic has about reached its height in Washington. New England will be the last section to feel the outbreak, which should be over even there by the end of January. Subsequent outbreaks of milder intensity may follow, but the major one, which started on the West Coast early in November and worked its way across the South and now is reaching northern states, is about played out.

For the week ending December 24, the latest for which figures are available, a total of 123,138 cases was reported. This is more than three times the number recorded the preceding week.

Science News Letter, January 7, 1933

...E FIELDS

COSMOGONY

Astronomer Suggests New Earth Origin Theory

THE EARTH and the moon were born out of the parent spiral nebula that fathered not only the sun but all the other stars of the Milky Way, is the suggestion of Dr. Harlow Shapley, of Harvard, made at the meeting of the American Association for the Advancement of Science. This scrapping of the most widely accepted theories of the origin of the earth and other planets of the sun's family is sure to create great interest and fresh thought among astronomers.

The Shapley theory makes the moon, planets and sun all the same age, the progeny of a "secondary swirl or eddy of the parental spiral nebula out of which the local galaxy or Milky Way may be supposed to have generated." The conventional theory is that the earth and planets were born when a passing star pulled matter like gaseous taffy out of the sun, and some have theorized that the moon was cleaved off the earth at an even later time.

Science News Letter, January 7, 1933

PUBLIC HEALTH

Diphtheria Protection Should be Given First

GIVE CHILDREN toxoid to build up their resistance to diphtheria before vaccinating them against smallpox, is the advice suggested by studies of Dr. Charles Armstrong of the U. S. Public Health Service. This should make the reaction to the smallpox vaccination comparatively mild and should avoid such complications as postvaccination encephalitis.

Furthermore, diphtheria is now a greater hazard to children in the United States than smallpox, so it would seem logical to protect against it first. In recent years the diphtheria death-rate has been 70 times as high as the smallpox death-rate in this country.

Dr. Armstrong's studies of postvaccination encephalitis, a serious complication which has appeared in recent years, led him to advise that all first vaccinations should be done in infancy, in order to avoid the encephalitis.

His latest studies seem to show that the defensive mechanism which is called into play by vaccination or immunization needs a certain amount of preliminary exercise before it is equal to coping with the smallpox vaccine. Diphtheria toxoid apparently furnishes this exercise without causing encephalitis. Therefore Dr. Armstrong believes that the first vaccination in children over one year of age should follow and not precede immunization against diphtheria or some other disease for which the immunizing agent is inanimate.

Science News Letter, January 7, 1933

PLANT PHYSIOLOGY

Poison Gas Stimulates Plants to Form New Roots

CARBON MONOXIDE, notorious as a poisoner of incautious motorists who start engines in closed garages, can play an opposite and beneficial role for propagators of plant cuttings. It has a specific action on plant tissues, causing them to sprout new roots in shorter time, or even to produce roots where otherwise no roots would grow at all.

Researches by which this fact was demonstrated were reported before the physiological section of the Botanical Society of America by Drs. P. W. Zimmerman, William Crocker and A. E. Hitchcock of the Boyce Thompson Institute for Plant Research.

A wide variety of plants, both woody and herbaceous, were tried, Among others were tobacco, marigold, balsam and hydrangea. New roots were induced to form on young portions of the stems of all plants tried, and on three of them roots even formed on the leaves.

In addition to stimulating the formation of entirely new roots, the gas also spurred into vigorous activity the already existing beginnings of roots in twenty different plant species.

The gas was effective over a wide range of concentrations ranging from 0.05 per cent. to 50 per cent. The time of exposure necessary to induce the response varied with the species from two days to twenty.

Three other gases, acetylene, propylene and butylene, have been found effective for inducing roots to form somewhat as reported for carbon monoxide.

Science News Letter, January 7, 1933

MEDICINE

One-Way Light Reveals Viruses to be Rod-shaped

FOR THE FIRST time, evidence on the possible shape of the active particles in the filtrable viruses that cause such diseases as smallpox, yellow fever, hog cholera and plant mosaics was placed before a scientific body, when Drs. William N. Takahashi and T. E. Rawlins of the University of California presented their report to botanists attending the meeting of the American Association for the Advancement of Science.

If the invisible, filter-passing particles in these viruses have the shape of tiny rods, the two researchers reasoned, they should present a bright appearance if light waves arranged all in one direction fall on them at the proper angle. Accordingly, they directed a beam of polarized light, in which all wave-fronts are parallel, upon a solution of a virus flowing from a small tube. The solution did present a bright appearance, confirming the experimenters' hypothesis.

Science News Letter, January 7, 1933

ENTOMOLOGY

Insects' Blood Coagulates Like That of Man

THE BLOOD of insects, though widely different from the blood of man and the other backboned animals in appearance and makeup, has at least one thing in common: it coagulates or clots. At the meeting of the Entomological Society of America, Dr. J. Franklin Yeager and Dr. Harry H. Knight, of Iowa State College, presented data on their experiments with blood samples from 47 different species of insects.

Their method was to put a drop of insect blood into a drop of oil on a glass slide, and then observe changes through a microscope. The blood of different insect species displayed wide differences in behavior, they found. Some species have blood that coagulates in its plasma, or fluid part; while the blood of others shows only blood cell coagulation. Still other species have blood that will hardly coagulate at all. The two experimenters were unable to trace a correlation between blood coagulation behavior and classification of insects, or between coagulation and stage of development in any given line.

Science News Letter, January 7, 1933

ASTRONOMY

Bright Stars in January

Though There is a Dearth of Visible Planets, Nine Stars Of First Magnitude Invite Attention to the Evening Sky

By JAMES STOKLEY

JANUARY always brings a glorious display of stars in the evening sky. Even though the year is starting out with a singular dearth of visible planets, except later in the evening and in the early morning, the nine first magnitude stars that can now be seen after dinner well warrant more than a passing glance skywards.

As you look to the south, at perhaps nine o'clock, you will probably first notice Orion, most magnificent of the constellations. Orion is easily identified. The three stars that form the heavenly warrior's belt, though not of the first magnitude, are his unmistakable trademark. Above and to the east of the belt is Betelgeuse, a reddish star of the first magnitude, while below, directly opposite Betelgeuse, is Rigel, also of the first magnitude.

Slightly higher than Orion and more to the west is a very red star, Aldebaran, which marks the group of Taurus, the bull, with which Orion is supposed to be fighting, according to the old pictures. Below Orión is another brilliant star; in fact, it is the brightest in the sky. This is Sirius which marks the constellation of Canis Major, the greater of the two dogs that accompany the warrior. The other dog, Canis Minor, is farther to the east. Its lucida, or brightest star, is Procyon which is only slightly inferior to Sirius.

High overhead and a little to the north of the zenith is the second brightest star now visible, Capella, in Auriga, the charioteer. Capella is the third most brilliant star ever seen from this latitude and the fifth in the entire sky. Besides Sirius, it is exceeded by Canopus and alpha Centauri, two stars that can only be seen from southern countries, and Vega, which will come into the evening sky in April.

Now look below Auriga to the east. There you will see two bright stars, one of which is of the first magnitude. The brighter star is Pollux, one of the twins, Gemini. The fainter star is his brother, Castor. Still lower in the east is a star group almost as familiar as the Great Dipper. This is the Sickle, part of the constellation of Leo, the lion. The Sickle is now placed with its handle downwards and to the right, and the blade curving upwards and to the right. Brilliant Regulus is the end of the handle.

The stars mentioned are eight of the nine first magnitude stars now visible in the evening sky, and they will remain with us for several months to come. The ninth, which is now about to leave us until the summer, is Deneb in Cygnus, the swan. Low in the northwest it may be seen, even after the rest of the constellation has vanished beyond the horizon. In the early part of the evening you can see most of the "Northern Cross," of which it marks the head, standing upright in the west.

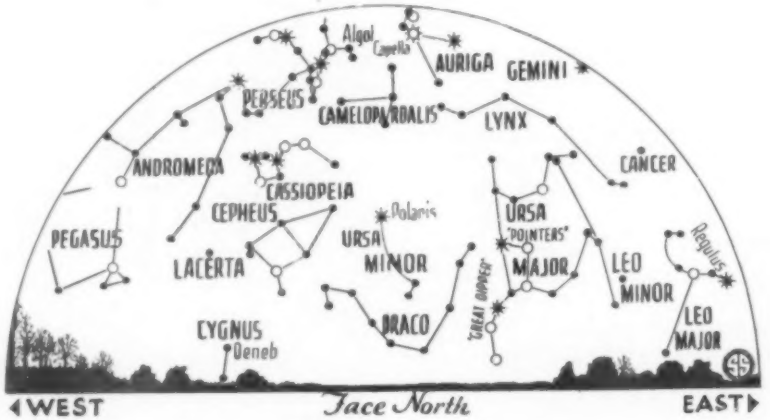
Planets Rise Late

No planets are to be seen during the earlier part of the evening this month, and none are shown on the maps, which represent the appearance of the sky about 10 p. m. on the first, about 9 p. m. on the fifteenth and about 8 p. m. on the thirty-first. However, if Mars were but a little farther west, it would manage to get on the map. It is now in the constellation of Virgo, next to Leo, in which it rises above the eastern horizon about ten o'clock in the middle of the month. By midnight it is well up in the eastern sky and its steady red glow makes it easy to distinguish. It remains visible during the rest of the night.

Venus appears in the eastern morning sky about two hours before sunrise. Mercury, which was visible during December, is still to the west of the sun so close to it that it rises when the glare of morning twilight is over-poweringly bright. Saturn, which was conspicuous in the south during the summer and autumn, is similarly placed to the east of the sun, where it sets before the evening twilight fades sufficiently to allow it to be seen.

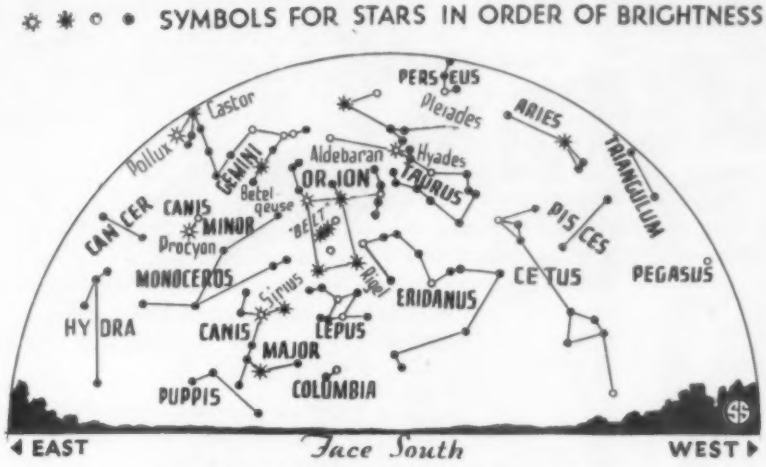
During January the moon goes through its phases as follows. On the third it was at first quarter and directly south at sunset. On the eleventh it is full, rising at sunset and remaining visible all night. On the nineteenth it is at last quarter. Then it rises at midnight. On the twenty-fifth it is new, almost directly in line with the sun and therefore invisible. But a day or two later the young crescent can be glimpsed in the west in the evening sky. Because of the dates of these phases, the evenings from the first of the month to about the sixteenth will be moonlit.

At this time of year the astronomer, like other people, is inclined to look ahead, and see what the year has in store for him. Unlike last year, there is no promise of a total eclipse of the sun in an easily accessible part of the earth. During every year there must be at least two eclipses, and this year we have the



ABOUT TO LEAVE

The star Deneb, low in the northwest, will soon vanish behind the horizon.



MOST MAGNIFICENT CONSTELLATION

In the southern sky brilliant Orion will catch your attention first.

minimum. Though these have little scientific interest, they should attract considerable attention in the regions over which they pass. It is not the fact that they occur in remote parts of the earth that deters astronomers from observing them, for eclipse experts have frequently travelled half way around the world. Both eclipses of 1933 are annular. That is, the moon is then a little farther from the earth than on the average, and its apparent diameter is a little less than usual. Even though it comes directly between the sun and earth, the moon will not completely cover the sun. A ring, or "annulus," of sunlight will remain visible. The glare from this annulus is so bright that none of the phenomena of a total eclipse can be observed.

The year's first eclipse comes on February 24. The path over which the moon can be viewed completely surrounded by sunlight crosses Chile, Argentina, the South Atlantic Ocean, Central Africa, including Belgian Congo, the Sudan and Ethiopia, and Arabia. Over the entire southern half of South America, most of Africa and southwestern Asia, the inhabitants will see a partial eclipse, more of the sun being covered the nearer they are to the path of the annulus.

The second eclipse is on August 21, and has a path that brings to mind the stories of the Arabian Nights. It starts in Egypt, passes over Palestine, Iraq, Persia, India, Siam, Borneo and northern Australia. Such interesting cities as Alexandria, Jerusalem, Bagdad, Calcutta and Rangoon are in it. The partial eclipse will be witnessed over most of Europe, except the British Isles, Spain and the southwestern half of France; but it will occur early in the morning. In central Europe, the sun will rise partially eclipsed. The partial phases will also be observed in northwestern Africa, and in most of Asia, Polynesia and Australia.

To Prepare for Eclipse

Though 1933 brings no worthwhile eclipses, so far as the astronomer is concerned, he will give much thought to eclipse preparations before the year is over. The next total eclipse occurs in 1934 on St. Valentine's day and is visible over a path crossing Borneo, Celebes, and several small islands in the South Pacific. Several expeditions will doubtless be located along the path, but the places where the eclipse can best be seen are off the usual steamer routes, so specially chartered ships will be required, and a large quantity of material for erecting the scientific instruments will have to be taken along. Astronomers observing this eclipse will probably spend Christmas many miles from home.

Several comets are sure to arrive during 1933. One never knows when a new comet, rivalling in brilliance the famous ones of the past, may flash unheralded into the night or even the day sky. But there are numerous periodic comets that come back regularly. Among those expected this year are the Pons-Winnecke comet, which comes every six years and was last seen in 1927. It was discovered in 1819 and has been observed on ten returns since then, several having been missed for one reason or another. The Giacobini-Zinner comet, which returns every six and two-thirds years and was last observed in 1926, is also scheduled for a 1933 visit. Its known history dates back to 1900. Finlay's comet, which was first observed in 1886 and was last seen in 1926, and Wolf's comet, which came last in 1925 having been discovered in 1884, are also expected to put in an appearance this year.

In addition, November may bring a good return of the Leonid meteors. Unlike the conditions prevailing last year at the time when a nearly full moon contributed its glare to render invisible the fainter meteors, or shooting stars, the moon will be out of the way this year and scientists will watch the skies with interest.

Science News Letter, January 7, 1933

PUBLIC HEALTH

Towns Change Water Supply To Prevent Tooth Defects

THE FIRST two instances in the history of dentistry of communities changing their water supplies in order to prevent a defect of the teeth of their inhabitants were reported by Dr. Frederick S. McKay, New York City dentist, to the American Association for the Advancement of Science.

The change has been made by two communities in this country in order to prevent the condition known as mottled enamel. The condition was observed about 25 years ago in certain Western communities. Recent research showed that it was due to the presence of fluorine in the drinking water. Wherever there is more than two parts per million of fluorine in the water, mottled enamel occurs, and when there is less than that amount, mottled enamel is absent.

Margaret Cammack Smith at the University of Arizona reproduced the mottled enamel condition in laboratory rats by feeding them concentrated water containing fluorine from one of the afflicted districts. Dr. McKay pointed out that while it would not be ethical to perform such an experiment on man, the experiment has already been unwittingly performed in the commu- (*Turn Page*)

nities having fluorine-bearing water supplies.

The results of the communities' experiment will not be fully apparent for about six or seven years, when the teeth formed subsequent to the change of water will have erupted into the mouth.

Areas effected have been found in Arizona, Arkansas, California, Colorado, Idaho, Illinois, Minnesota, New Mexico, North and South Dakota, Texas, Virginia, Kansas, North Carolina, Oregon, Washington and foreign countries.

Science News Letter, January 7, 1933

PHYSIOLOGY

Secretion From Crustacean Eyes Causes Color Changes

EYES act as glands, in certain animals at least, secreting a substance that causes the contraction of color-bodies in their skins and thus controls their chameleon-like color changes. Experiments pointing to this hormone-production by eyes were reported by Prof. Lloyd M. Bertholf, of the University of Western Maryland before the American Society of Zoologists.

The animals furnishing the color-changing extract were crustacea, the great zoological family comprising lobsters, crabs, crayfish and their kin. The hormone was found in their eye-stalks.

The eye-stalk extract, when injected into the body, produced color changes not only in crustacea, but in frog tadpoles and several species of fishes—animals far removed in the zoological realm from the invertebrate crustacea.

Science News Letter, January 7, 1933

From Page 3

come a part of it. Neutrons would not be repelled, and would probably have a better chance of going in. We do not know enough about them yet to estimate the chances; but a tolerable idea of the probability of penetration of a proton can be obtained by means of wave-mechanics. The chances are best for the lightest nuclei, which have the smallest charges and repulsive forces. Calculations by Atkinson and Houtermans show that such penetrating collisions would begin to become important when the temperature of the gas rose above a few million degrees."

The rate of heat-production by atomic synthesis increases very rapidly with the temperature. In a gas containing hydrogen, oxygen, nitrogen and carbon, all of which are very abundant in the stars, heat should be produced fast enough to keep the stars shining at temperatures of about 20 million degrees, Prof. Russell estimates. The internal temperatures of most of the stars appear to be just of this order, and it is probable that they are deriving their heat supply from processes of atomic synthesis of this general nature. What supplies the giant stars, which must be much cooler inside, unless they have dense cores, is still unknown.

The Russell theory is greatly strengthened by a kind of energy-releasing element building demonstrated this year by Drs. J. D. Cockcroft and E. T. S. Walton at Cavendish Laboratory, Cambridge, England. Lithium, lightest metallic element, was bombarded with protons or the hearts of hydrogen atoms, accelerated by a potential drop of 300,000 volts. Alpha rays, which are helium nuclei, were given off with a total energy corresponding to 16,000,000 volts.

A proton evidently enters a lithium nucleus, produces a beryllium isotope which breaks up into two alpha particles. The energy due to loss of mass sets the alpha particles in very rapid motion.

Science News Letter, January 7, 1933

From Page 4

dynamics it would necessarily have uniform temperature throughout.

Another example cited by Prof. Tolman is "the possibility for reversible processes at a finite rate" which would be impossible under classical theory.

The ordinary principle of energy conservation fails under relativistic mechanics and Prof. Tolman holds out the idea that under the new thermodynamics "an unending succession of irreversible expansions and contractions which seems very strange from the point of view of classical thermodynamics" can actually occur. And this would happen without "a final state of maximum entropy" or a running down of the system to a dead level of heat.

These extensions of relativity to heat, energy and motion made by Prof. Tolman will sound as bizarre to those accustomed to physics as now taught as Einstein's new physics seemed when first made known to the world.

In present the new models of the universe possible under his new relativistic thermodynamics, Prof. Tolman warned that they were very highly simplified and idealized and that at best they are constructed to agree with the small sample of the actual universe that is within range of the most powerful telescopes. Those reach only some hundred million light years.

It is also possible, he warned, to construct a model universe that would expand never to return. Only research of the future will determine whether the real universe is expanding and contracting indefinitely, expanding like a balloon inflated by limitless breath or acting in some unknown way.

Science News Letter, January 7, 1933

Scientists, recording the intensity of sounds in decibels, give the following figures: hammering on steel plate, 113 decibels; riveter, 101; subway, 97; lion roaring, 87; radio loudspeaker, 81; church bells, 61.

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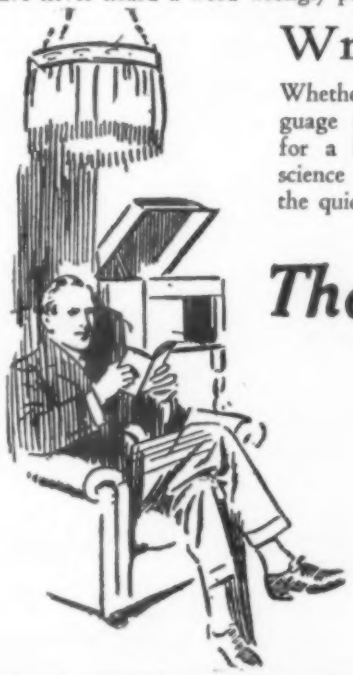

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ASTRONOMY

Time Studies Suggest Distance To Europe Varies With Moon

REGARDLESS of the state of British-American amity, the distance between the United States and England appears to vary each day as the moon moves across the sky. If the hypothesis advanced to the American Astronomical Society by Dr. Harlan T. Stetson, director of the Perkins Observatory at Delaware, Ohio, and Alfred L. Loomis, of the Loomis Laboratory, Tuxedo, N. Y., is correct, the change in distance is about 63 feet. They make this suggestion to account for surprising variations in British and American time which have been uncovered by Mr. Loomis' researches.

With what is probably the most complete installation of the latest type of precision clocks in the world, and automatic radio sets to record time signals from a number of national observatories, he has found that the times do not agree. Even when the corrections published by the British Admiralty for their time signals from the radio station at Rugby, and those of the Naval Observatory for the Annapolis signals, are applied, there is still a slight difference, often as much as a tenth of a second, between them, despite the fact that both are correct.

The time is determined at both places by observing the instant that a star crosses the meridian. Therefore, if the two observatories are shifting slightly in longitude, the star will cross slightly early when it is west of the average, and late when it is to the east. In the absence of any other satisfactory explanation, Dr. Stetson and Mr. Loomis have adopted the idea that such a shift does take place. It does not matter whether either one or both of the observatories is moving; it is the distance between them that produces the effect.

The Loomis-Stetson hypothesis to explain this variation in step with the moon's position is that there is a natural stretching or shifting in the earth's crust, within its elastic limits, which would yield and recover periodically under the stress of the moon's gravitational pull.

Another result of the studies is the indication that the radio wave takes twice as long to cross the Atlantic as would a beam of light travelling the same distance. This, they believe, is due to the fact that the radio waves do not travel directly, but are reflected repeatedly from the Kennelly-Heaviside layer high above the earth's surface. The time taken corresponds to some thirty such reflections. They find that this time also varies with the moon's position in the sky, and attribute this to an actual tidal effect in the layer, produced by the moon's pull.

Science News Letter, January 7, 1933

The effect of marine climate on paintings and art objects is being investigated by the International Museums Office, with a view to knowing the best precautions against damage in overseas transportation.

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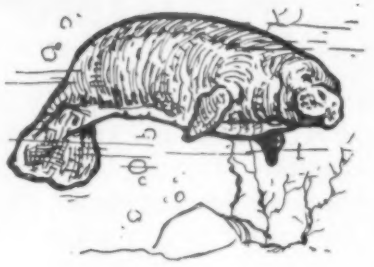
ZOOLOGY

NATURE RAMBLINGS
by Frank Thone



Sea-Cows

FLORIDA real estate is a great subject for the ribald jest of the skeptical. But the favorite joke about selling sea bottom to the unsuspecting investor may some day fall flat. The bottom of the sea, or at least of the shallow lagoons and river mouths, has some promise; if not as building lots, at least as cattle pasture. Sea-cow pasture, anyway.

In the warm streams around the coasts of Florida there grows a plant called locally "manatee grass," a favorite pasture of the manatee, or sea-cow. A great lubberly creature is the sea-cow, not a fish, but a mammal that has taken to water and developed flippers instead of legs, like the walrus and the whale. She is valuable for both flesh and oil, and possibly also for leather. Chemical analysis of the manatee grass shows it to be richer in food value than alfalfa. Sea-cow ranching seems to be a really distinct possibility, for the animals are both stupid and tractable, and it is possible to impound the shallow waters in which they browse.

Sea-cows evidently were known to the mariners of early modern times, whose accounts, losing nothing in the telling, were further magnified by credulous authors who traveled by arm-chair route. An old wood-cut shows a very literal "sea-cow," with formidable horns, a belligerent eye, and a mouth opened wide in a ferocious bellow. The accompanying text states that "The Sea-Cow is a huge Monster, strong, angry, and injurious," which, to anyone who knows the real manatee, is a most untruthful slander.

Science News Letter, January 7, 1933

The moon reflects only about one-fourteenth of the sunlight falling on it.

From Page 5

in the hydrogen molecule was followed by London's suggestion that the same method applied to two approaching molecules would lead to an activation energy which might well explain at least some of the observed activation energies. It is, perhaps, well to consider what is meant by an activation energy. A reaction between two molecules can only occur during the rare cataclysmically violent encounters in which a particular atom being so near a new one is as apt to depart with the new partner as to return to the old one. This unusual situation is called the activated state and the energy with which they must collide is the activation energy. To calculate the activation energy involves a knowledge of the energy with which pairs of atoms are held together. The suggestion that the spectra of diatomic molecules would suffice for the evaluation of these quantities was embodied in a paper by Eyring and Polanyi. In this paper the activation energy calculated for the conversion of para-hydrogen to the equilibrium mixture was found to approximate closely the experimental findings. Calculations of a later paper indicated correctly the particular mechanism by which the various halogens react with hydrogen. The reaction of hydrogen and fluorine is particularly interesting because of the frequent statements in the literature that the reaction proceeds even at very low temperatures. The calculations indicate it is really the least reactive of the halogens and is only able to react at ordinary temperatures after a chain has been started by a catalyst or some dissociating agent. The large amount of heat released by the reaction of even a few atoms, however, makes an explosion extremely probable. The method also enables us to eliminate as extremely improbable certain proposed mechanisms in the hydrogen, chlorine photochemical reaction. A satisfactory picture of the catalytic conversion of ortho- to para-hydrogen at a surface has been obtained. The concentration of the heavy hydrogen isotope in water by electrolysis is a necessary corollary from this point of view arising from the lower zero point energy of the adsorbed heavy isotope. We thus bring to a new problem a reasonable certainty of the essential correctness of a method which in view of the approximations might otherwise be open to rather serious doubts. It is to be emphasized that all of these results and those to follow involve no assumptions not introduced in the original paper of the series, and that qualitatively the conclusions are even largely independent of these assumptions.

The question as to why bromine adds to the first and fourth carbon atoms of butadiene (with the consequent disappearance of the two end double bonds and the appearance of a double bond between carbon atoms two and three) has long been a question for speculation. Our calculations show that 1,4 addition should proceed with an activation energy roughly 10 kilo calories less than 1,2 addition and that the former compound even when formed is more stable than the latter by almost as many calories. Thus 1,2 dibrombutadiene even if formed would rearrange at moderate temperatures to the 1,4 compound. The same calculations for hydrogen instead of bromine indicate that homogeneous hydrogenation can only proceed at a very much higher temperature than bromination so that the results will probably be impossible of experimental verification because of alternative polymerization reactions. Similar calculations indicate that so far as we may judge by energy considerations a satisfactory picture of the benzene ring is obtained by regarding six of the twenty-four valence electrons on the carbon atoms as paired with the six electrons of the hydrogen atoms. Twelve more form six single bonds between carbon atoms and the additional six electrons by rapidly oscillating between all the possible ways of forming bonds between them provide approximately the additional binding energy observed. The activation energy for the hydrogenation of such a benzene molecule is then calculated in the manner previously outlined.

There is thus accumulating an empirical foundation for the method more compelling than that which may at present be adduced from strictly theoretical considerations. The qualitative correctness in all cases of the calculations indicate that it is a surprisingly powerful tool with which to attack the almost endless variety of problems of chemical mechanism.

Science News Letter, January 7, 1933

Manufacturers of incandescent lamps turn out approximately 3,000 kinds, including many unusual designs made only on special order.

PHYSICS

Economic Revolution Seen As Atom Releases Energy

THE BEGINNING of an economic revolution is seen by Prof. Bergen Davis, Columbia University physicist, in the successful extraction of energy from the heart of the atom that has been accomplished within the past year.

When Dr. J. D. Cockcoft and E. T. S. Walton at Britain's Cavendish Laboratory this spring smashed the lithium atom and obtained 16,000,000 electron-volts energy for an input of only a few hundred thousand electron-volts, this was a landmark in the conquests of physical science, in Prof. Davis' opinion.

In delivering the vice-presidential address in physics before the American Association for the Advancement of Science, Prof. Davis predicted that the younger physicists listening to him may see and take part in a remarkable revolution in physical science and in industry.

"Enormous stores of energy will be made available and mankind will be largely relieved from physical toil," he declared.

"The methods of using this nuclear energy are not yet developed, but new discoveries will be made," Prof. Davis said. "The difficulties will be rapidly overcome. One might imagine the following hypothetical process. The bombardment of aluminium by alpha-particles gives high energy protons. The bombardment of lithium by protons gives high energy alpha-particles. By bombarding a mixture of aluminium and lithium with protons the future physicist may start a process similar to but much more intense than the more familiar thermite reaction. The mixture in a certain sense is an explosive mixture. It contains within itself the possibility of maintaining the action if it is once started."

Science News Letter, January 7, 1933

First Glances at New Books

General Science

THE NATURAL SCIENCES—Bernhard Bavink, transl. by H. Stafford Hatfield—*Century,* 683 p., $7.50. The world is again seeing men who are bold enough to take all knowledge to be their province. Here is a German who can sum up all present learning without appearing oppressively learned, and who can philosophize about it aferwards without talking like a professor of philosophy. He invokes religion without being nervously apologetic about it, and winds up his book with a fine emotional flourish like a coda of one of the three composers who, he says, can come closer to solving the eternal riddle of good against evil than any philosopher: Bach, Beethoven and Brahms.

Science News Letter, January 7, 1933

Entomology

THE AMERICAN BOYS' BOOK OF BUGS, BUTTERFLIES AND BEETLES—Dan Beard—*Lippincott,* 365 p., $3. The Master of all American Scoutmasters sets forth, lit with flashes of humor and leavened with bits of philosophic idea-leading, a lot of interesting lore about three insect groups which boys are apt to find interesting. The line drawings are his own, too—and Dan Beard can draw!

Science News Letter, January 7, 1933

Medical Economics

A COMMUNITY MEDICAL SERVICE ORGANIZED UNDER INDUSTRIAL AUSPICES IN ROANOKE RAPIDS, NORTH CAROLINA—I. S. Falk, Don M. Griswold and Hazel I. Spicer—*University of Chicago Press,* 105 p., 90c. One of the last publications of the Committee on the Costs of Medical Care, before that organization disbanded after making its final report. Surveys of industrial medical schemes such as this led the Committee to report in favor of community medical centers.

Science News Letter, January 7, 1933

Geology

THERMAL SPRINGS OF VIRGINIA—Frank Reeves—*Virginia Geological Survey,* 56 p., maps, 4c. postage. This survey presents studies of springs in the unusual warm springs region of Virginia and West Virginia, 85 of which were found to have an annual mean temperature greater than 55 degrees Fahrenheit. The temperature of the warmest spring is 105.8 degrees and the flow of the largest about 6,000 gallons per minute at a temperature which varies seasonally from 65 to 74 degrees. A group of three springs discharges more than 1,000 gallons per minute at temperatures greater than 95 degrees.

Science News Letter, January 7, 1933

Forestry

FOREST EDUCATION—H. S. Graves and C. H. Guise—*Yale Univ. Press,* 421 p., $2.50. To everyone who is interested in American forestry (and all Americans should be), this book is at once an education and a challenge. It tells completely of what is being done for the education of the future custodians of our forests, and it outlines a program of what ought to be done that leaves even the best of our present efforts looking rather inadequate. But unless this country is going to make up its mind to a future of cellulose starvation this challenge must be met. The study on which this book is based was initiated by the National Academy of Sciences and carried forward under the Society of American Foresters through a grant made by the Carnegie Corporation.

Science News Letter, January 7, 1933

Speech

CORRECTION OF DEFECTIVE SPEECH—Edwin Burket Twitmyer and Yale Samuel Nathanson—*Blakiston's,* 413 p., $3.50. This book aims not only to help those with speech defects but to "improve the general output of modal speech." The authors give exercises, diagrams and pictures as well as a theoretical discussion of their method, which is the result of years of clinical experience.

Science News Letter, January 7, 1933

Archaeology-Ethnology

DISTRIBUTION OF THE ABORIGINAL POPULATION OF MICHIGAN—W. B. Hinsdale—*Univ. of Michigan Press,* 35 p., 65c. While this monograph deals specifically with Indians of one state, it contains much general information on the factors that limited and directed the distribution of population in aboriginal America.

Science News Letter, January 7, 1933

Chemistry

CHEMICAL UTILIZATION OF WOOD—Henry K. Benson—*National Committee on Wood Utilization,* 150 p., 15c. One of the most important raw materials in modern industrial chemistry is wood. Former waste products of wood are now being transformed by chemical research into a variety of products ranging from smokeless powder to cellophane and from sugar to motor fuel. Dr. Benson, who compiled this material while Chairman of the Division of Chemistry and Chemical Technology of the National Research Council, has adequately presented the different chemical processes and their products for the information of research and industrial workers.

Science News Letter, January 7, 1933

Geology-Ecology

ALPINE ZONE OF MT. WASHINGTON RANGE — Ernst Antevs—*Merrill and Webber, Auburn, Maine,* 118 p., $2. One of the world's most competent glaciologists sums up in a compact pocket-size little volume all the essential knowledge about one of the most interesting of the world's accessible high-mountain areas.

Science News Letter, January 7, 1933

Paleontology

ON A NEWLY MOUNTED SKELETON OF DIPLODOCUS IN THE UNITED STATES NATIONAL MUSEUM—C. W. Gilmore—*Smithsonian Institution,* 21 p., 6 pl. This modest booklet describes the skeleton of a beast 70 feet long that required half-a-dozen years of steady work to put where the public can say, "Oh my!" at it.

Science News Letter, January 7, 1933

Genetics

PRINCIPLES OF GENETICS—E. W. Sinnott and L. C. Dunn—*McGraw-Hill,* 441 p., $3.50. Genetics is notoriously one of the fastest-developing of all the biological disciplines. Even in the few years since the first edition of this book appeared, so much progress has been made that the authors have found it best to revise so completely that the result is practically a new work.

Science News Letter, January 7, 1933

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